City of Thornton

Standley Lake Facilities

Specifications

September, 2020

CITY OF THORNTON
STANDLEY LAKE FACILITIES
SPECIFICATIONS

TABLE OF CONTENTS

SECTION 01 00 00 - GOVERNING PRIORITIES

PART 1 – GENERAL

1.1 DIVISION 0 GOVERNS OVER DIVISION 1

A. All of the information in Division 1 is supplemental to Division 0.

B. For all of the work of Division 1 reference is made to Division 0, whether stated explicitly or not. Additional requirements are also provided to supplement that mentioned in Division 0. In case of a conflict between Division 1 and Division 0, Division 0 shall govern, unless otherwise specifically noted.

1.2 ADDITIONAL INFORMATION

A. Payment for all of the work of Division 1 and Division 0 shall be considered incidental and payment will be understood to be included as part of the lump sum or unit bid prices in the Bid Form, unless otherwise specifically noted.

B. For all of the work of Division 2 through 49 (Technical Specifications), the requirements of Division 0 and especially Division 1 are incorporated as if re-written in each individual Specification Section.

C. Unless explicitly stated otherwise, in case of a conflict between the requirements of Division 2 through 49 and the requirements of Division 1 or Division 0, the more stringent requirements, in the opinion of the Owner, shall apply.

D. Unless explicitly stated otherwise, in case of a conflict between the requirements of any Sections in any of the Division 1 through 49, the more stringent requirements, in the opinion of the Owner, shall apply.

E. Unless explicitly stated otherwise, in case of a conflict between the Drawings and the Specifications, the more stringent requirements, in the opinion of the Owner, shall apply.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 11 00 - SUMMARY OF WORK

PART 1 -- GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

A. The WORK of this project consists of installation of access locations on the Standley Lake Pipeline. Access locations include steel specials with manways and weld-on outlet taps.

B. All areas disturbed during the course of the WORK shall be restored as indicated on the DRAWINGS and as specified herein. Site restoration will include, but is not limited to, all backfill and compaction, finish grading, temporary/permanent asphalt pavement replacement and temporary roadway marking, curb and gutter replacement, seeding, installation of fencing, and cleanup.

1.2 EXPRESSION OF CONTRACTOR RESPONSIBILITY IN THE TECHNICAL SPECIFICATIONS

A. Whenever in the Technical Specifications requirements are expressed with active verbs and no subjects, the words, "The Contractor shall," have been omitted as a matter of style, meaning that the Contractor is the party responsible for taking the action required.

1.3 EMPLOYMENT OF LABOR

A. None but skilled workers shall be employed on the Work requiring special qualifications. When requested in writing by Owner, the Contractor or any Subcontractor shall discharge any person who is, in the opinion Owner, incompetent, unfaithful, disorderly or otherwise unsatisfactory, and shall not again employee such discharge person on the Work except with the written consent of Owner. Such discharge shall not be the basis of any Claim for compensation or damages against Owner, the Engineer or their respective directors, officers, employees, agents, consultants or designated volunteers.

1.4 WORK BY OTHERS

A. Interference with Work on Utilities: Contractor shall cooperate fully with all utility forces of the Owner or forces of other public or private agencies engaged in the relocation, altering, or otherwise rearranging of any facilities which interfere with the progress of Work, and shall schedule Work so as to minimize interference with said relocation, altering, or other rearranging of facilities. Contractor’s attention is directed to Section 01 50 10 – Protection of Existing Facilities for known requirements regarding utility coordination.

1.5 WORK SEQUENCE

A. Contractor shall schedule and perform Work in such manner to achieve all milestone completion dates. Contractor shall also schedule and perform Work to conform to other dates, times, and time durations required as part of this Work and the work of

others. Refer to Section 01 14 00 - Construction Constraints for more requirements regarding sequencing and schedule constraints.

1.6 CONTRACTOR USE OF SITE

A. Contractor shall confine its operations to the Work areas indicated on the drawings.

B. Contractor's use of Site shall be limited to its construction operations, including on-Site storage of materials, equipment, parking of Contractor employee vehicles, on-Site fabrication facilities, and field offices. Refer to Section 01 55 00 - Site Access and Storage.

C. Restricted areas are not available to Contractor during performance of Work. Contractor shall be prohibited from entering any restricted areas. No work shall occur outside of Thornton's easement. Refer to Section 01 55 00 - Site Access and Storage.

D. Night and weekend work may be performed where not specifically prohibited by Owner or agencies having jurisdiction, provided that written notification has been provided to City of Thornton Project Manager a minimum of 48-hours prior to the start of night or weekend work. Written notification must also be provided to the agency having jurisdiction in the time frame required by the agency having jurisdiction. Refer to Section 01 41 26 – Permits and Agreements for restriction of working hours by agencies having jurisdiction.

E. No Work shall be allowed on holidays as defined in the Contract Documents.

1.7 OWNER USE OF PROJECT SITE

A. Owner may utilize all or part of the existing Site and existing facilities during the entire period of construction for the conduct of Owner's normal operations, observation of the Work, and for other Owner projects. Cooperate and coordinate with the City of Thornton Project Manager to facilitate Owner's operations and projects and to minimize interference with Contractor's operations at the same time. In any event, Owner shall be allowed safe access to all portions of the Site during the period of construction of the Project.

1.8 NOTICES TO OWNERS OF ADJACENT PROPERTIES AND UTILITIES

A. Maintain access to all public and private properties at all times through the use of detours or alternate routes or entrances unless written permission is obtained from the property owner or tenant prior to closing such access.

B. Utilities and other concerned agencies shall be contacted prior to cutting streets or other traffic areas or excavating near underground utilities or pole lines in accordance with Section 01 50 10 – Protection of Existing Facilities.

C. Review with the various utility companies the construction methods, safety procedures, and Work to be done in the vicinity of utilities. When temporary relocation of utilities is necessary, sufficient advance notice shall be given by Contractor to the utility involved, as required by the utility company.

1.9 LINES AND GRADES

A. Work shall be done to the lines, grades, and elevations indicated, within the tolerances below except where otherwise indicated and where dimensions are indicated to be minimum, or specified in other sections of the Contract Documents. Maintain slopes and drainage as indicated. Regardless of tolerance limits, no reverse grading will be permitted. No enclosed depressions or high and low points shall be allowed unless specifically indicated.

Non-grade critical areas (refer to Note 1 below).	± 6 inches
Grade critical areas and areas within the 100-year flood plain.	± 1 inch
Graded dirt roads or pads	± 2 inches
Foundations for structures	± 1 inch
Paved roads and parking lots	± 1 inch
Drainage ditches and swales	± 1 inch
Buried pipelines smaller than 48-inches in diameter	± 1-inch vertical, ± 2-inches horizontal, unless indicated otherwise
Buried pipelines 48-inches and larger in diameter	± 2.5 percent of diameter vertical, ± 5 percent of diameter horizontal, unless indicated otherwise

B. Note 1 - Non-grade Critical Areas: The Contractor may distribute excess native spoils material at properties where grade is non-critical, within the construction limits and in accordance with the table above. Grades shall conform to grade tolerances indicated. Non-grade critical tolerances shall not apply to areas within the 100-year floodplain. Areas within the 100 year floodplain shall be restored to original grade to within the tolerances specified.

C. Non-grade critical areas generally consist of dry land farmed areas or other areas that are not row irrigated. Grade critical areas are typically, row irrigated lands or other lands where restoration of the existing grade is critical. These classifications do not consider whether the property is within the 100 year floodplain, which is indicated on the Drawings. Areas within the 100 year floodplain shall be restored to original grade to within the tolerances specified, regardless of the classification made in this section.

D. Tolerances for finish grades are subject to adjustment as indicated at transition from new, to existing surfaces. Provide uniform grade and match elevations at such transitions.

E. Basic horizontal and vertical control points as provided in General Conditions, Reference Points and are shown on drawing(s) and electronic copies of select surveyed sites may be provided. Any additional surveys, layouts, or measurements needed for proper construction of Work shall be performed by Contractor.

F. Keep City of Thornton Project Manager informed, a reasonable time in advance, of the times and places at which Contractor wishes to do Work, so that horizontal and vertical control points may be established and any checking deemed necessary by City of Thornton Project Manager may be done with minimum delay to Contractor.

G. Contractor shall remove and reconstruct Work that is improperly located.

H. Unless otherwise indicated, existing grades and grades prepared by others are accurate only to within one-half of the contour interval for the topography indicated or plus or minus one-foot, whichever is greater. If no contour interval is indicated, existing grades shall be considered accurate to plus or minus one foot. No additional payment will be made for extra grading, excavation, fill, backfill, structural fill, or related materials and Work effort of any kind unless the actual grades at the beginning of the Work differ from those indicated by more than the accuracy limits indicated above.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 11 00 - SUMMARY OF WORK

PART 1 -- GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

A. The WORK of this project consists of installation of access locations on the Standley Lake Pipeline. Access locations include steel specials with manways and weld-on outlet taps. WORK will consist of two construction mobilization periods: Fall of 2021 and Spring of 2022.

B. All areas disturbed during the course of the WORK shall be restored as indicated on the DRAWINGS and as specified herein. Site restoration will include, but is not limited to, all backfill and compaction, finish grading, temporary/permanent asphalt pavement replacement and temporary roadway marking, curb and gutter replacement, seeding, installation of fencing, and cleanup.

1.2 EXPRESSION OF CONTRACTOR RESPONSIBILITY IN THE TECHNICAL SPECIFICATIONS

A. Whenever in the Technical Specifications requirements are expressed with active verbs and no subjects, the words, "The Contractor shall," have been omitted as a matter of style, meaning that the Contractor is the party responsible for taking the action required.

1.3 EMPLOYMENT OF LABOR

A. None but skilled workers shall be employed on the Work requiring special qualifications. When requested in writing by Owner, the Contractor or any Subcontractor shall discharge any person who is, in the opinion Owner, incompetent, unfaithful, disorderly or otherwise unsatisfactory, and shall not again employee such discharge person on the Work except with the written consent of Owner. Such discharge shall not be the basis of any Claim for compensation or damages against Owner, the Engineer or their respective directors, officers, employees, agents, consultants or designated volunteers.

1.4 WORK BY OTHERS

A. Interference with Work on Utilities: Contractor shall cooperate fully with all utility forces of the Owner or forces of other public or private agencies engaged in the relocation, altering, or otherwise rearranging of any facilities which interfere with the progress of Work, and shall schedule Work so as to minimize interference with said relocation, altering, or other rearranging of facilities. Contractor’s attention is directed to Section 01 50 10 – Protection of Existing Facilities for known requirements regarding utility coordination.

1.5 WORK SEQUENCE

A. Contractor shall schedule and perform Work in such manner to achieve all milestone completion dates. Contractor shall also schedule and perform Work to conform to other dates, times, and time durations required as part of this Work and the work of

others. Refer to Section 01 14 00 - Construction Constraints for more requirements regarding sequencing and schedule constraints.

1.6 CONTRACTOR USE OF SITE

A. Contractor shall confine its operations to the Work areas indicated on the drawings.

B. Contractor's use of Site shall be limited to its construction operations, including on-Site storage of materials, equipment, parking of Contractor employee vehicles, on-Site fabrication facilities, and field offices. Refer to Section 01 55 00 - Site Access and Storage.

C. Excavation cannot occur on the active waterline. Contractor shall coordinate waterline shutdown with the Owner prior to beginning construction.

D. Restricted areas are not available to Contractor during performance of Work. Contractor shall be prohibited from entering any restricted areas. No work shall occur outside of Thornton's easement. Refer to Section 01 55 00 - Site Access and Storage.

E. Night and weekend work may be performed where not specifically prohibited by Owner or agencies having jurisdiction, provided that written notification has been provided to City of Thornton Project Manager a minimum of 48-hours prior to the start of night or weekend work. Written notification must also be provided to the agency having jurisdiction in the time frame required by the agency having jurisdiction. Refer to Section 01 41 26 – Permits and Agreements for restriction of working hours by agencies having jurisdiction.

F. No Work shall be allowed on holidays as defined in the Contract Documents.

1.7 OWNER USE OF PROJECT SITE

A. Owner may utilize all or part of the existing Site and existing facilities during the entire period of construction for the conduct of Owner's normal operations, observation of the Work, and for other Owner projects. Cooperate and coordinate with the City of Thornton Project Manager to facilitate Owner's operations and projects and to minimize interference with Contractor's operations at the same time. In any event, Owner shall be allowed safe access to all portions of the Site during the period of construction of the Project.

1.8 NOTICES TO OWNERS OF ADJACENT PROPERTIES AND UTILITIES

A. Maintain access to all public and private properties at all times through the use of detours or alternate routes or entrances unless written permission is obtained from the property owner or tenant prior to closing such access.

B. Utilities and other concerned agencies shall be contacted prior to cutting streets or other traffic areas or excavating near underground utilities or pole lines in accordance with Section 01 50 10 – Protection of Existing Facilities.

C. Review with the various utility companies the construction methods, safety procedures, and Work to be done in the vicinity of utilities. When temporary relocation

of utilities is necessary, sufficient advance notice shall be given by Contractor to the utility involved, as required by the utility company.

1.9 LINES AND GRADES

A. Work shall be done to the lines, grades, and elevations indicated, within the tolerances below except where otherwise indicated and where dimensions are indicated to be minimum, or specified in other sections of the Contract Documents. Maintain slopes and drainage as indicated. Regardless of tolerance limits, no reverse grading will be permitted. No enclosed depressions or high and low points shall be allowed unless specifically indicated.

Non-grade critical areas (refer to Note 1 below).	± 6 inches
Grade critical areas and areas within the 100-year flood plain.	± 1 inch
Graded dirt roads or pads	± 2 inches
Foundations for structures	± 1 inch
Paved roads and parking lots	± 1 inch
Drainage ditches and swales	± 1 inch
Buried pipelines smaller than 48-inches in diameter	± 1-inch vertical, ± 2-inches horizontal, unless indicated otherwise
Buried pipelines 48-inches and larger in diameter	± 2.5 percent of diameter vertical, ± 5 percent of diameter horizontal, unless indicated otherwise

B. Note 1 - Non-grade Critical Areas: The Contractor may distribute excess native spoils material at properties where grade is non-critical, within the construction limits and in accordance with the table above. Grades shall conform to grade tolerances indicated. Non-grade critical tolerances shall not apply to areas within the 100-year floodplain. Areas within the 100 year floodplain shall be restored to original grade to within the tolerances specified.

C. Non-grade critical areas generally consist of dry land farmed areas or other areas that are not row irrigated. Grade critical areas are typically, row irrigated lands or other lands where restoration of the existing grade is critical. These classifications do not consider whether the property is within the 100 year floodplain, which is indicated on the Drawings. Areas within the 100 year floodplain shall be restored to original grade to within the tolerances specified, regardless of the classification made in this section.

D. Tolerances for finish grades are subject to adjustment as indicated at transition from new, to existing surfaces. Provide uniform grade and match elevations at such transitions.

E. Basic horizontal and vertical control points as provided in General Conditions, Reference Points and are shown on drawing(s) and electronic copies of select surveyed sites may be provided. Any additional surveys, layouts, or measurements needed for proper construction of Work shall be performed by Contractor.

F. Keep City of Thornton Project Manager informed, a reasonable time in advance, of the times and places at which Contractor wishes to do Work, so that horizontal and vertical control points may be established and any checking deemed necessary by City of Thornton Project Manager may be done with minimum delay to Contractor.

G. Contractor shall remove and reconstruct Work that is improperly located.

H. Unless otherwise indicated, existing grades and grades prepared by others are accurate only to within one-half of the contour interval for the topography indicated or plus or minus one-foot, whichever is greater. If no contour interval is indicated, existing grades shall be considered accurate to plus or minus one foot. No additional payment will be made for extra grading, excavation, fill, backfill, structural fill, or related materials and Work effort of any kind unless the actual grades at the beginning of the Work differ from those indicated by more than the accuracy limits indicated above.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 14 00 - CONSTRUCTION CONSTRAINTS

PART 1 -- GENERAL

1.1 GENERAL

A. Schedule, sequence, and perform Work in a manner which minimizes disruption to the public and to the operation and maintenance of existing facilities.

1.2 SPECIFIC CONSTRAINTS

A. The listing of constraints below does not mean that every constraint or special condition has been identified. Constraints and special conditions listed below do not relieve the Contractor of the responsibility for coordination and planning for completion of the Work in accordance with the Contract.

1. Fall 2021 construction duration: Excavation can begin on October 4th and the waterline must be complete and backfilled by October 29th. Other activities may continue beyond October 29th.

2. Spring 2022 construction duration: Excavation can begin on April 11th and the waterline must be complete and backfilled by May 6th. Other activities may continue beyond May 6th.

3. Excavation cannot occur on the active waterline. Contractor shall coordinate waterline shutdown with the Owner prior to beginning construction

4. Coordinate constraints associated with environmentally sensitive areas in accordance with Section 01 57 19 – Temporary Environmental Controls.

5. Coordinate constraints associated with various railroad permits, as indicated in Section 01 41 26 – Permits and Agreements.

6. Coordinate constraints associated with various agency permits and agreements, as indicated in Section 01 41 26 – Permits and Agreements.

7. Maintain safe access to Work and adjacent properties in accordance with Specification Section 01 35 29 – Health and Safety.

8. The properties below are categorized as either “non-grade critical areas” or “grade critical areas”. Non-grade critical areas generally consist of dry land farmed areas, open space, or other areas that are not row irrigated. In these areas the Contractor shall be able to distribute excess native spoils from pipe installation within the construction limits, to within the tolerances specified in Section 01 11 00 – Summary of Work. Grade critical areas are typically streets, roadways, pedestrian paths or sidewalks, row irrigated lands or others lands where restoration of the existing grade is critical. These classifications do not consider whether the property is within the 100 year floodplain, which is indicated on the Drawings. Areas within the 100 year floodplain shall be restored to original grade

to within the tolerances specified, regardless of the classification made in this section.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 14 16 - PUBLIC AND MEDIA RELATIONS

PART 1 -- GENERAL

1.1 SECTION INCLUDES

A. Contractor responsibilities to minimize inconvenience to the public, and to provide information to the Owner and the Owner's Public Information Representative.

1.2 DEFINITIONS

A. ADA: Americans with Disabilities Act.

B. Affected Parties: Includes all residential and business properties including, but not limited to churches, day care centers, hotels, community centers and schools within 500 yards from either side or the end of all scheduled work locations.

C. Emergency: Here, the term "emergency" shall mean incidents in which injuries or accidents 1) occur within the construction zone and/or 2) involve construction equipment, and/or 3) disrupt or block the flow of traffic, and clearance is anticipated to take more than ten (10) minutes.

D. Emergency Responders: Includes, but not limited to, fire department, emergency medical, and police agencies having jurisdiction in the area of the work.

E. HS&E: Health, Safety and Environment.

F. City of Thornton Information Representative:

Name: Kristin Schwartz
Address: 12450 Washington St. Thornton, CO 80241
Telephone: 720-977-6234
E-mail: infrastructuredept@thorntonco.gov

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

2.1 GENERAL

A. Maintain access at all times, including ADA, to all Affected Parties through the use of detours, alternate routes or entrances unless written permission is obtained from the property owner or tenant prior to closing such access.

B. Minimize the inconvenience to the public at all times, including but not limited to restricting night work, noise and dust (refer to Section 01 57 19 – Temporary Environmental Controls and Section 01 41 26 – Permits and Agreements)

C. Assist the Owner and the Public Information Representative in keeping the public informed by providing accurate and timely information when so requested.

2.2 PUBLIC NOTIFICATION

A. Contractor shall be responsible for notifying Emergency Responders of all detours and access restrictions to streets or driveways.

B. Contractor shall inform Affected Parties of utility disruptions or traffic control plans prior to the start of those operations, as directed by the Owner.

C. In some instances, the Owner may ask the Contractor to hand deliver public notifications.

2.3 EMERGENCY RESPONSE

A. In the event of any emergency, immediately notify the Owner and the Public Information Representative.

B. In the event that an emergency situation will last more than two hours, the Contractor may be required to provide bottled water to Affected Parties. Disruptions spanning a 24-hour period may require that the Contractor house Affected Parties in Owner approved hotels.

2.4 CITIZEN INTERACTION

A. When necessary, Contractor meetings with Affected Parties will be arranged by the Public Information Representative.

B. If approached by a citizen with questions or concern about the project, the Contractor shall give only basic facts of the project and direct the citizen to contact the Owner or Public Information Representative to learn more.

C. If approached by a citizen with questions or concern about the project, the Contractor shall remedy the complaint on the spot whenever possible. If the complaint cannot be resolved immediately, advise the customer to contact the Public Information Representative for assistance.

2.5 MEDIA INTERACTION

A. The Contractor and the Contractor’s agents are not authorized to speak to the media. If media arrives at the work site, contact the Owner or the Public Information Representative. If asked for information by the media, say nothing and direct inquiries to the Owner or the Public Information Representative.

- END OF SECTION -

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 -- GENERAL

1.1 FIELD ORDERS

A. City of Thornton Project Manager will issue Field Orders electronically contacting the project manager via email.

B. Effective date of the Field Order shall be the date of signature by Owner's Project Manager, unless otherwise indicated thereon.

C. Field Orders will be incorporated into subsequent Change Orders as no-cost changes to the Contract.

1.2 CHANGE ORDERS

A. Requests for Quotation

1. Owner may, in anticipation of ordering an addition, deletion, or revision to the Work, request Contractor to prepare a detailed quotation of cost and times to perform contemplated change.

2. Request for Quotation will include reference number for tracking purposes and detailed description of and reason for proposed change, and such additional information as appropriate and as may be required for Contractor to accurately estimate cost and time impact on Project.

3. Request for Quotation is for information only; Contractor is neither authorized to execute proposed change nor to stop Work in progress as result of such request.

4. Contractor's written quotation shall be transmitted to City of Thornton Project Manager promptly via email, but not later than 14 days after Contractor's receipt of Owner's written request. The quotation shall remain firm for a maximum period of 45 days after receipt by City of Thornton Project Manager.

5. Owner's Request for Quotation or Contractor's failure to submit such quotation within the required time period will not justify a Claim for an adjustment in Contract Price or Contract Times (or Milestones).

1.3 CHANGE ORDER PROCEDURE

A. Once the quotation is agreed to by Owner and Contractor, the City of Thornton Project Manager will prepare a Change Order proposal and transmit such to Contractor for signature.

B. Contractor shall, upon receipt, either: (i) promptly sign the proposal, and return to the City of Thornton Project Manager for Owner's signature, or (ii) return unsigned proposal with written justification for not executing Change Order.

C. City of Thornton Project Manager will upon receipt of Contractor signed copy, promptly forward partially executed copy for Owner's signature, or if Contractor refuses or fails to execute the Change Order, City of Thornton Project Manager will promptly so notify Owner and transmit Contractor's justification to Owner.

D. Upon receipt of Contractor-executed Change Order proposal, Owner will promptly either:

1. Execute a Change Order, retaining the original copy for its file and returning a copy to City of Thornton Project Manager, or

2. Return to City of Thornton Project Manager unsigned copy with written justification for not executing Change Order.

E. Upon receipt of Owner-executed Change Order, City of Thornton Project Manager will transmit one copy to Contractor, one copy to Engineer, and retain one copy, or if Owner fails to execute the Change Order, City of Thornton Project Manager will promptly so notify Contractor and transmit Owner's justification to Contractor. City of Thornton Project Manager shall then send an electronic copy of the Owner-executed change order.

F. Upon receipt of Owner-executed Change Order, Contractor shall:

1. Perform Work covered by Change Order.

2. Revise Schedule of Values to adjust Contract Price and submit with next Application for Payment.

3. Revise Progress Schedule to reflect changes in Contract Times, if any, and to adjust times for other items of Work affected by change.

4. Enter changes in Project record documents after completion of change related Work.

G. In signing a Change Order, Owner and Contractor acknowledge and agree that:

1. Stipulated compensation (Contract Price or Contract Times, or both) set forth includes payment for (i) the Cost of the Work covered by the Change Order, (ii) Contractor's fee for overhead and profit, (iii) interruption of Progress Schedule, (iv) delay and impact, including cumulative impact, on other Work under the Contract Documents, and (v) extended overheads.

2. Change Order constitutes full mutual accord and satisfaction for the change to the Work;

3. Unless otherwise stated in the Change Order, all requirements of the original Contract Documents apply to the Work covered by the Change Order.

1.4 WORK CHANGE DIRECTIVES

A. Procedures

1. City of Thornton Project Manager will initiate Work Change Directives, including a description of the Work involved and any attachments. The City of Thornton Project Manager will obtain Designer and Owner review and acceptance in the Electronic Document Management System.

2. Upon completion of Work covered by the Work Change Directive or when Contract Times and Contract Price is determined for that change, Contractor shall submit documentation for inclusion in a Change Order.

3. Contractor's documentation shall include but not be limited to:

a. Appropriately detailed records of Work performed to enable determination of cost of the Work.

b. Full information required to substantiate resulting change in Contract Times and Contract Price for Work. On request of City of Thornton Project Manager, provide additional data necessary to support documentation.

c. Support data for Work performed on a unit price or Cost of the Work basis with additional information such as:

i. Dates Work was performed, and by whom.

ii. Time records, signed daily by the City of Thornton Project Manager, wage rates paid, and equipment rental rates.

iii. Invoices and receipts for materials, equipment, and subcontracts, all similarly documented.

4. Effective Date of Work Change Directive: Date of signature by Owner, unless otherwise indicated thereon.

1.5 CLAIMS

A. All claims must comply with Article 10 of the General Conditions.

B. Include the following documentation, at a minimum:

1. Specific references including (i) Drawing numbers, (ii) Specification section and article/paragraph number, and (iii) Submittal type, Submittal number, date reviewed, Engineer's comment, as applicable, with appropriate attachments.

2. Stipulated facts and pertinent documents, including photographs and statements.

3. Interpretations relied upon.

4. Description of (i) nature and extent of Claim, (ii) who or what caused the situation, (iii) impact to the Work and work of others, and (iv) discussion of claimant's justification for requesting a change to price or times or both.

5. Estimated adjustment in price claimant believes it is entitled to with full documentation and justification.

6. Requested Change in Contract Times: Include at least (i) Progress Schedule documentation showing logic diagram for request, (ii) documentation that float times available for Work have been used, and (iii) revised activity logic with durations including sub-network logic revisions, duration changes, and other interrelated schedule impacts, as appropriate.

7. Documentation as may be necessary as set forth below for Work Change Directive, and as City of Thornton Project Manager may otherwise require.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 29 76 - MEASUREMENT AND PAYMENT

PART 1 -- GENERAL

1.1 MEASUREMENT - GENERAL

A. Weighing, measuring, and metering devices used to measure quantity of materials for Work shall be suitable for purpose intended and conform to tolerances and specifications as specified in National Institute of Standards and Technology, Handbook 44.

B. Whenever pay quantities of material are determined by weight, material shall be weighed on scales furnished by Contractor and certified accurate by state agency responsible. Weight or load slip shall be obtained from weigh station and delivered to City of Thornton Project Manager at point of delivery of material.

C. If material is shipped by rail, car weights will be accepted provided that actual weight of material only will be paid for and not minimum car weight used for assessing freight tariff, and provided further that car weights will not be acceptable for material to be passed through mixing plants.

D. Vehicles used to haul material being paid for by weight shall be weighed empty daily and at such additional times as required by the City of Thornton Project Manager. Each vehicle shall bear a plainly legible identification mark.

E. Materials that are specified for measurement by the cubic yard measured in the vehicle shall be hauled in vehicles of such type and size that actual contents may be readily and accurately determined. Unless all vehicles are of uniform capacity, each vehicle must bear a plainly legible identification mark indicating its water level capacity. Vehicles shall be loaded to at least their water level capacity. Loads hauled in vehicles not meeting above requirements or loads of a quantity less than the capacity of the vehicle, measured after being leveled off as above provided, will be subject to rejection, and no compensation will be allowed for such material.

F. Quantities Based on Profile Elevations**:** Existing ground profiles indicated on Drawings were taken from a topographic map drawn with contour intervals of 1 foot.

G. Quantities will be based on ground profiles shown. Field surveys will not be made to confirm accuracy of elevations shown.

H. Where measurement of quantities depends on elevation of existing ground, elevations obtained during construction will be compared with those shown on Drawings. Variations of 1 foot or less will be ignored, and profiles shown on Drawings will be used for determining quantities.

I. Units of measure shown on Bid Form shall be as follows, unless specified otherwise.

J. Pipe measurement shall be based on horizontal stationing as indicated in the Drawings.

Item	Method of Measurement
AC	Acre—Field Measure by City of Thornton Project Manager
CY	Cubic Yard—Field Measure by City of Thornton Project Manager within limits specified or shown
CY-VM	Cubic Yard—Measured in Vehicle by Volume
EA	Each—Field Count by City of Thornton Project Manager
GAL	Gallon—Field Measure by City of Thornton Project Manager
HR	Hour
LB	Pound(s)—Weight Measure by Scale
LF	Linear Foot—Field Measure by City of Thornton Project Manager
LS	Lump Sum—Field Percentage Measure by City of Thornton Project Manager
MFBM	Thousand Foot Board Measure— Field Measure by City of Thornton Project Manager
SF	Square Foot
SY	Square Yard
TON	Ton—Weight Measure by Scale (2,000 pounds)

1.2 PAYMENT

A. Payment for all Lump Sum and Unit Price Work shown or specified in Contract Documents is included in the Contract Price. Payment will be based on a percentage complete basis for each lump sum line items and actual Work completed for unit price line items of the accepted Bid Form.

B. Payment for Lump Sum Work covers all Work specified or shown within the limits or Specification sections as follows:

Item No.	Item	Description	Measurement and Payment
BASE BID			
Fall 2021			
1.	Mobilization/ Demobilization (LS)	This item includes obtaining of all permits and conformance to all permit requirements, bonds, insurance, public and media relations, administrative items, moving onto the site, furnishing and erecting temporary construction facilities, project signs, quality assurance/quality control, and all other work and operations that must be performed or costs incurred before beginning Work on all site, as well as demobilization and project closeout, all as required for the complete and proper performance and completion of the Work. Mobilization/demobilization efforts are anticipated to occur twice due to splitting construction into two seasons: Fall 2021 and Spring 2022.	Payment will be made based on the Lump Sum price in the Bid Form, as follows: 1. The initial request for payment will be made for either: a.) Twenty-five percent of the cost of this bid item, or b) the amount of the cost of the payment and performance bonds as proven with a paid invoice plus twenty-five percent of the cost of this bid item minus the bond costs. 2. The next 60% of the Lump Sum price in the Bid Form may be requested when 10% or more of the BID AMOUNT is earned. 3. The final 15% of the Lump Sum price in the Bid Form may be requested upon demobilization from the site.
2.	Erosion Control and Fencing (LS)	This item includes erosion control measures and BMPs at sites 2-4, including construction fencing, silt fencing, vehicle tracking pads, and other BMPs, and agency coordination as shown on the drawings and in the SWMP, including furnishing and handling all required labor, equipment and materials.	Payment will be made based on the amount of approved work performed and materials furnished.

Item No.	Item	Description	Measurement and Payment
3.	Rock Excavation (CY)	Rock excavation, as defined by Specification 31 23 00, including stockpiling, haul-off, furnishing and handling all required labor, equipment and materials.	Payment will be made based on the amount of approved work performed as a unit measure of work completed under this bid item.
4.	Dewatering of excavations (LS)	Dewatering of excavations at sites 2-4 including control of, and removal and disposal of groundwater, installing, operating, maintaining, and removing dewatering well points, pumps, piping, and equipment, furnishing and handling all required labor, equipment and materials, and permits. Any crushed rock or pea gravel, pumping systems and under drain systems used in or near the trench as part of the dewatering operation shall be included in this bid item.	Measurement for this item will be on work completed as determined by the Owner and City of Thornton Project Manager. Payment shall be made based on the lump sum and description provided in the bid tabulation.
5.	Asphalt Access Path Restoration (LF)	This item includes all materials, equipment, labor, and incidentals for all work required to restore the asphalt access path to pre-construction condition, or better as indicated in the Contract Documents. Work includes but is not limited to replacement of construction access paths that is comprised of leveling, raking, addition of surface materials, seeding and mulching, with City of Thornton approved seed mix, including furnishing and handling all required equipment, materials, labor, and cleanup in conformance with the drawings, specifications, and City of Thornton requirements, and maintenance of seeded areas until receipt of Final Payment.	Payment will be made based on the amount of approved work performed as a unit measure of work completed under this bid item.
6.	Concrete Restoration (LF)	This item includes all materials, equipment, labor, and incidentals for all work required to restore concrete access path, curb and gutter to pre-construction condition, or better as indicated in the Contract Documents. Work includes but is not limited to replacement of construction access paths that is comprised of leveling, raking, addition of surface materials, including furnishing and handling all required equipment, materials, labor, and cleanup in conformance with the drawings, specifications, and City of Thornton requirements.	Payment will be made based on the amount of approved work performed as a unit measure of work completed under this bid item.

Item No.	Item	Description	Measurement and Payment
7.	Utility Potholing (EA)	This item includes all materials, equipment, labor, and incidentals for all work required to verify utility/feature depths and locations by potholing per utility locates. Coordinating with utility companies, locating and protecting all existing utilities in and along the project reach, identifying the utility type, depth, and dimensions prior to construction, backfilling potholes with flashfill/flowfill and patching roadway, as required by City of Thornton, and providing all other related and necessary labor, equipment, and materials to complete the Work. Utilities exposed and protected as part of the construction operations are not included in this item.	Payment will be made based on the units completed and accepted (EA).
8.	Drawing series 100: Sta. 23+00 Steel Special Installation with 60-inch diameter Manhole (LS)	Removal and disposal of approximately 6-feet of the existing 36-inch diameter bar wrapped pipe. Work includes site survey, staking, new manhole installation, stockpiling, haul-off, removal and disposal of the existing manhole (if applicable), installation of pre-fabricated steel pipe special, cathodic protection, and backfill as shown on the design drawings. This item also includes all materials, equipment, labor, and incidentals for all work required to restore all disturbed areas to their pre-construction condition, or better as indicated in the Contract Documents. Work includes but is not limited to establishing site grade, surface roughening, mowing, removal/replacement of fencing, asphalt paving, concrete walks, curbs, landscaping or other improvements as necessary for construction, revegetation of grassy areas that is comprised of seeding and mulching, with City of Thornton approved seed mix, including furnishing and handling all required equipment, materials, labor, and cleanup in conformance with the drawings, specifications, and City of Thornton requirements, and maintenance of seeded areas until receipt of Final Payment.	Payment will be made based on the amount of materials furnished and approved work performed as a percentage of work completed under this bid item.

Item No.	Item	Description	Measurement and Payment
9.	Drawing series 100: Sta. 47+00 Steel Special Installation with 60-inch diameter Manhole (LS)	Removal and disposal of approximately 6-feet of the existing 36-inch diameter bar wrapped pipe. Work includes site survey, staking, new manhole installation, stockpiling, haul-off, removal and disposal of the existing manhole (if applicable), installation of pre-fabricated steel pipe special, cathodic protection, and backfill as shown on the design drawings. This item also includes all materials, equipment, labor, and incidentals for all work required to restore all disturbed areas to their pre-construction condition, or better as indicated in the Contract Documents. Work includes but is not limited to establishing site grade, surface roughening, mowing, removal/replacement of fencing, asphalt paving, concrete walks, curbs, landscaping or other improvements as necessary for construction, revegetation of grassy areas that is comprised of seeding and mulching, with City of Thornton approved seed mix, including furnishing and handling all required equipment, materials, labor, and cleanup in conformance with the drawings, specifications, and City of Thornton requirements, and maintenance of seeded areas until receipt of Final Payment.	Payment will be made based on the amount of materials furnished and approved work performed as a percentage of work completed under this bid item.

Item No.	Item	Description	Measurement and Payment
10.	Drawing series 100: Sta. 81+00 Steel Special Installation with 60-inch diameter Manhole (LS)	Removal and disposal of approximately 6-feet of the existing 36-inch diameter bar wrapped pipe. Work includes site survey, staking, new manhole installation, stockpiling, haul-off, removal and disposal of the existing manhole (if applicable), installation of pre-fabricated steel pipe special, cathodic protection, and backfill as shown on the design drawings. This item also includes all materials, equipment, labor, and incidentals for all work required to restore all disturbed areas to their pre-construction condition, or better as indicated in the Contract Documents. Work includes but is not limited to establishing site grade, surface roughening, mowing, removal/replacement of fencing, asphalt paving, concrete walks, curbs, landscaping or other improvements as necessary for construction, revegetation of grassy areas that is comprised of seeding and mulching, with City of Thornton approved seed mix, including furnishing and handling all required equipment, materials, labor, and cleanup in conformance with the drawings, specifications, and City of Thornton requirements, and maintenance of seeded areas until receipt of Final Payment.	Payment will be made based on the amount of materials furnished and approved work performed as a percentage of work completed under this bid item.
11.	Traffic Control	Includes all costs for furnishing and handling all required labor, equipment, and materials for all required project traffic control. Includes preparation of and obtaining approval of traffic control plans and detours, coordinating with governing jurisdictions, permitting, furnishing, installing and maintaining barriers and detour routes and other traffic control devices and personnel.	Payment for this item will be made based on the Lump Sum price in the Bid Form.

Item No.	Item	Description	Measurement and Payment
Spring 2022			
12.	Mobilization/ Demobilization (LS)	This item includes obtaining of all permits and conformance to all permit requirements, bonds, insurance, public and media relations, administrative items, moving onto the site, furnishing and erecting temporary construction facilities, project signs, quality assurance/quality control, and all other work and operations that must be performed or costs incurred before beginning Work on all site, as well as demobilization and project closeout, all as required for the complete and proper performance and completion of the Work. Mobilization/demobilization efforts are anticipated to occur twice due to splitting construction into two seasons: Fall 2021 and Spring 2022.	Payment will be made based on the Lump Sum price in the Bid Form, as follows: 1. The initial request for payment will be made for either: a.) Twenty-five percent of the cost of this bid item, or b) the amount of the cost of the payment and performance bonds as proven with a paid invoice plus twenty-five percent of the cost of this bid item minus the bond costs. 2. The next 60% of the Lump Sum price in the Bid Form may be requested when 10% or more of the BID AMOUNT is earned. 3. The final 15% of the Lump Sum price in the Bid Form may be requested upon demobilization from the site.
13.	Erosion Control and Fencing (LS)	This item includes erosion control measures and BMPs at sites 7 and 9, including construction fencing, silt fencing, vehicle tracking pads, and other BMPs, and agency coordination as shown on the drawings and in the SWMP, including furnishing and handling all required labor, equipment and materials.	Payment will be made based on the amount of approved work performed and materials furnished.
14.	Rock Excavation (CY)	Rock excavation, as defined by Specification 31 23 00, including stockpiling, haul-off, furnishing and handling all required labor, equipment and materials.	Payment will be made based on the amount of approved work performed as a unit measure of work completed under this bid item.

Item No.	Item	Description	Measurement and Payment
15.	Dewatering of excavations (LS)	Dewatering of excavations at sites 7 and 9 including control of, and removal and disposal of groundwater, installing, operating, maintaining, and removing dewatering well points, pumps, piping, and equipment, furnishing and handling all required labor, equipment and materials, and permits. Any crushed rock or pea gravel, pumping systems and under drain systems used in or near the trench as part of the dewatering operation shall be included in this bid item.	Measurement for this item will be on work completed as determined by the Owner and City of Thornton Project Manager. Payment shall be made based on the lump sum and description provided in the bid tabulation.
16.	Concrete Restoration (LF)	This item includes all materials, equipment, labor, and incidentals for all work required to restore concrete access path, curb and gutter to pre-construction condition, or better as indicated in the Contract Documents. Work includes but is not limited to replacement of construction access paths that is comprised of leveling, raking, addition of surface materials, including furnishing and handling all required equipment, materials, labor, and cleanup in conformance with the drawings, specifications, and City of Thornton requirements.	Payment will be made based on the amount of approved work performed as a unit measure of work completed under this bid item.
17.	Utility Potholing (EA)	This item includes all materials, equipment, labor, and incidentals for all work required to verify utility/feature depths and locations by potholing per utility locates. Coordinating with utility companies, locating and protecting all existing utilities in and along the project reach, identifying the utility type, depth, and dimensions prior to construction, backfilling potholes with flashfill/flowfill and patching roadway, as required by City of Thornton, and providing all other related and necessary labor, equipment, and materials to complete the Work. Utilities exposed and protected as part of the construction operations are not included in this item.	Payment will be made based on the units completed and accepted (EA).

Item No.	Item	Description	Measurement and Payment
18.	Drawing series 100: Sta. 162+00 Steel Special Installation with 60-inch diameter Manhole (LS)	Removal and disposal of approximately 6-feet of the existing 36-inch diameter bar wrapped pipe. Work includes site survey, staking, new manhole installation, stockpiling, haul-off, removal and disposal of the existing manhole (if applicable), installation of pre-fabricated steel pipe special, cathodic protection, and backfill as shown on the design drawings. This item also includes all materials, equipment, labor, and incidentals for all work required to restore all disturbed areas to their pre-construction condition, or better as indicated in the Contract Documents. Work includes but is not limited to establishing site grade, surface roughening, mowing, removal/replacement of fencing, asphalt paving, concrete walks, curbs, landscaping or other improvements as necessary for construction, revegetation of grassy areas that is comprised of seeding and mulching, with City of Thornton approved seed mix, including furnishing and handling all required equipment, materials, labor, and cleanup in conformance with the drawings, specifications, and City of Thornton requirements, and maintenance of seeded areas until receipt of Final Payment.	Payment will be made based on the amount of materials furnished and approved work performed as a percentage of work completed under this bid item.

Item No.	Item	Description	Measurement and Payment
19.	Drawing series 200: Sta. 213+53 Outlet Tap Installation with 60-inch diameter Manhole (LS)	Modification to existing 36-inch diameter bar wrapped pipe. Work includes site survey, staking, new manhole installation, stockpiling, haul-off, removal and disposal of the existing manhole (if applicable), installation of 6-inch weld-on outlet on the existing 36-inch diameter bar wrapped pipe, cathodic protection, and backfill as shown on the design drawings. This item also includes all materials, equipment, labor, and incidentals for all work required to restore all disturbed areas to their pre-construction condition, or better as indicated in the Contract Documents. Work includes but is not limited to establishing site grade, surface roughening, mowing, removal/replacement of fencing, asphalt paving, concrete walks, curbs, landscaping or other improvements as necessary for construction, revegetation of grassy areas that is comprised of seeding and mulching, with City of Thornton approved seed mix, including furnishing and handling all required equipment, materials, labor, and cleanup in conformance with the drawings, specifications, and City of Thornton requirements, and maintenance of seeded areas until receipt of Final Payment.	Payment will be made based on the amount of materials furnished and approved work performed as a percentage of work completed under this bid item.
20.	Traffic Control	Includes all costs for furnishing and handling all required labor, equipment, and materials for all required project traffic control. Includes preparation of and obtaining approval of traffic control plans and detours, coordinating with governing jurisdictions, permitting, furnishing, installing and maintaining barriers and detour routes and other traffic control devices and personnel.	Payment for this item will be made based on the Lump Sum price in the Bid Form.

Item No.	Item	Description	Measurement and Payment
ALTERNATE BID			
21.	Mobilization/ Demobilization (LS)	This item includes obtaining of all permits and conformance to all permit requirements, bonds, insurance, public and media relations, administrative items, moving onto the site, furnishing and erecting temporary construction facilities, project signs, quality assurance/quality control, and all other work and operations that must be performed or costs incurred before beginning Work on all site, as well as demobilization and project closeout, all as required for the complete and proper performance and completion of the Work.	Payment will be made based on the Lump Sum price in the Bid Form, as follows: 1. The initial request for payment will be made for either: a.) Twenty-five percent of the cost of this bid item, or b) the amount of the cost of the payment and performance bonds as proven with a paid invoice plus twenty-five percent of the cost of this bid item minus the bond costs. 2. The next 60% of the Lump Sum price in the Bid Form may be requested when 10% or more of the BID AMOUNT is earned. 3. The final 15% of the Lump Sum price in the Bid Form may be requested upon demobilization from the site.
22.	Erosion Control and Fencing (LS)	This item includes erosion control measures and BMPs at all sites, including construction fencing, silt fencing, vehicle tracking pads, and other BMPs, and agency coordination as shown on the drawings and in the SWMP, including furnishing and handling all required labor, equipment and materials.	Payment will be made based on the amount of approved work performed and materials furnished.
23.	Rock Excavation (CY)	Rock excavation, as defined by Specification 31 23 00, including stockpiling, haul-off, furnishing and handling all required labor, equipment and materials.	Payment will be made based on the amount of approved work performed as a unit measure of work completed under this bid item.

Item No.	Item	Description	Measurement and Payment
24.	Dewatering of excavations (LS)	Dewatering of excavations at all sites including control of, and removal and disposal of groundwater, installing, operating, maintaining, and removing dewatering well points, pumps, piping, and equipment, furnishing and handling all required labor, equipment and materials, and permits. Any crushed rock or pea gravel, pumping systems and under drain systems used in or near the trench as part of the dewatering operation shall be included in this bid item.	Measurement for this item will be on work completed as determined by the Owner and City of Thornton Project Manager. Payment shall be made based on the lump sum and description provided in the bid tabulation.
25.	Asphalt Access Path Restoration (LF)	This item includes all materials, equipment, labor, and incidentals for all work required to restore the asphalt access path to pre-construction condition, or better as indicated in the Contract Documents. Work includes but is not limited to replacement of construction access paths that is comprised of leveling, raking, addition of surface materials, seeding and mulching, with City of Thornton approved seed mix, including furnishing and handling all required equipment, materials, labor, and cleanup in conformance with the drawings, specifications, and City of Thornton requirements, and maintenance of seeded areas until receipt of Final Payment.	Payment will be made based on the amount of approved work performed as a unit measure of work completed under this bid item.
26.	Concrete Restoration (LF)	This item includes all materials, equipment, labor, and incidentals for all work required to restore concrete access path, curb and gutter to pre-construction condition, or better as indicated in the Contract Documents. Work includes but is not limited to replacement of construction access paths that is comprised of leveling, raking, addition of surface materials, including furnishing and handling all required equipment, materials, labor, and cleanup in conformance with the drawings, specifications, and City of Thornton requirements.	Payment will be made based on the amount of approved work performed as a unit measure of work completed under this bid item.

Item No.	Item	Description	Measurement and Payment
27.	Utility Potholing (EA)	This item includes all materials, equipment, labor, and incidentals for all work required to verify utility/feature depths and locations by potholing per utility locates. Coordinating with utility companies, locating and protecting all existing utilities in and along the project reach, identifying the utility type, depth, and dimensions prior to construction, backfilling potholes with flashfill/flowfill and patching roadway, as required by City of Thornton, and providing all other related and necessary labor, equipment, and materials to complete the Work. Utilities exposed and protected as part of the construction operations are not included in this item.	Payment will be made based on the units completed and accepted (EA).
28.	Drawing series 100: Sta. 23+00 Steel Special Installation with 60-inch diameter Manhole (LS)	Removal and disposal of approximately 6-feet of the existing 36-inch diameter bar wrapped pipe. Work includes site survey, staking, new manhole installation, stockpiling, haul-off, removal and disposal of the existing manhole (if applicable), installation of pre-fabricated steel pipe special, cathodic protection, and backfill as shown on the design drawings. This item also includes all materials, equipment, labor, and incidentals for all work required to restore all disturbed areas to their pre-construction condition, or better as indicated in the Contract Documents. Work includes but is not limited to establishing site grade, surface roughening, mowing, removal/replacement of fencing, asphalt paving, concrete walks, curbs, landscaping or other improvements as necessary for construction, revegetation of grassy areas that is comprised of seeding and mulching, with City of Thornton approved seed mix, including furnishing and handling all required equipment, materials, labor, and cleanup in conformance with the drawings, specifications, and City of Thornton requirements, and maintenance of seeded areas until receipt of Final Payment.	Payment will be made based on the amount of materials furnished and approved work performed as a percentage of work completed under this bid item.

Item No.	Item	Description	Measurement and Payment
29.	Drawing series 100: Sta. 47+00 Steel Special Installation with 60-inch diameter Manhole (LS)	Removal and disposal of approximately 6-feet of the existing 36-inch diameter bar wrapped pipe. Work includes site survey, staking, new manhole installation, stockpiling, haul-off, removal and disposal of the existing manhole (if applicable), installation of pre-fabricated steel pipe special, cathodic protection, and backfill as shown on the design drawings. This item also includes all materials, equipment, labor, and incidentals for all work required to restore all disturbed areas to their pre-construction condition, or better as indicated in the Contract Documents. Work includes but is not limited to establishing site grade, surface roughening, mowing, removal/replacement of fencing, asphalt paving, concrete walks, curbs, landscaping or other improvements as necessary for construction, revegetation of grassy areas that is comprised of seeding and mulching, with City of Thornton approved seed mix, including furnishing and handling all required equipment, materials, labor, and cleanup in conformance with the drawings, specifications, and City of Thornton requirements, and maintenance of seeded areas until receipt of Final Payment.	Payment will be made based on the amount of materials furnished and approved work performed as a percentage of work completed under this bid item.

Item No.	Item	Description	Measurement and Payment
30.	Drawing series 100: Sta. 81+00 Steel Special Installation with 60-inch diameter Manhole (LS)	Removal and disposal of approximately 6-feet of the existing 36-inch diameter bar wrapped pipe. Work includes site survey, staking, new manhole installation, stockpiling, haul-off, removal and disposal of the existing manhole (if applicable), installation of pre-fabricated steel pipe special, cathodic protection, and backfill as shown on the design drawings. This item also includes all materials, equipment, labor, and incidentals for all work required to restore all disturbed areas to their pre-construction condition, or better as indicated in the Contract Documents. Work includes but is not limited to establishing site grade, surface roughening, mowing, removal/replacement of fencing, asphalt paving, concrete walks, curbs, landscaping or other improvements as necessary for construction, revegetation of grassy areas that is comprised of seeding and mulching, with City of Thornton approved seed mix, including furnishing and handling all required equipment, materials, labor, and cleanup in conformance with the drawings, specifications, and City of Thornton requirements, and maintenance of seeded areas until receipt of Final Payment.	Payment will be made based on the amount of materials furnished and approved work performed as a percentage of work completed under this bid item.

Item No.	Item	Description	Measurement and Payment
31.	Drawing series 100: Sta. 162+00 Steel Special Installation with 60-inch diameter Manhole (LS)	Removal and disposal of approximately 6-feet of the existing 36-inch diameter bar wrapped pipe. Work includes site survey, staking, new manhole installation, stockpiling, haul-off, removal and disposal of the existing manhole (if applicable), installation of pre-fabricated steel pipe special, cathodic protection, and backfill as shown on the design drawings. This item also includes all materials, equipment, labor, and incidentals for all work required to restore all disturbed areas to their pre-construction condition, or better as indicated in the Contract Documents. Work includes but is not limited to establishing site grade, surface roughening, mowing, removal/replacement of fencing, asphalt paving, concrete walks, curbs, landscaping or other improvements as necessary for construction, revegetation of grassy areas that is comprised of seeding and mulching, with City of Thornton approved seed mix, including furnishing and handling all required equipment, materials, labor, and cleanup in conformance with the drawings, specifications, and City of Thornton requirements, and maintenance of seeded areas until receipt of Final Payment.	Payment will be made based on the amount of materials furnished and approved work performed as a percentage of work completed under this bid item.

Item No.	Item	Description	Measurement and Payment
32.	Drawing series 200: Sta. 213+53 Outlet Tap Installation with 60-inch diameter Manhole (LS)	Modification to existing 36-inch diameter bar wrapped pipe. Work includes site survey, staking, new manhole installation, stockpiling, haul-off, removal and disposal of the existing manhole (if applicable), installation of 6-inch weld-on outlet on the existing 36-inch diameter bar wrapped pipe, cathodic protection, and backfill as shown on the design drawings. This item also includes all materials, equipment, labor, and incidentals for all work required to restore all disturbed areas to their pre-construction condition, or better as indicated in the Contract Documents. Work includes but is not limited to establishing site grade, surface roughening, mowing, removal/replacement of fencing, asphalt paving, concrete walks, curbs, landscaping or other improvements as necessary for construction, revegetation of grassy areas that is comprised of seeding and mulching, with City of Thornton approved seed mix, including furnishing and handling all required equipment, materials, labor, and cleanup in conformance with the drawings, specifications, and City of Thornton requirements, and maintenance of seeded areas until receipt of Final Payment.	Payment will be made based on the amount of materials furnished and approved work performed as a percentage of work completed under this bid item.
33.	Traffic Control	Includes all costs for furnishing and handling all required labor, equipment, and materials for all required project traffic control. Includes preparation of and obtaining approval of traffic control plans and detours, coordinating with governing jurisdictions, permitting, furnishing, installing and maintaining barriers and detour routes and other traffic control devices and personnel.	Payment for this item will be made based on the Lump Sum price in the Bid Form.

1.3 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT

A. Payment for materials delivered to the Site shall be in accordance with the General Conditions.

B. Partial Payment: No partial payments will be made for materials and equipment delivered or stored unless Shop Drawings or preliminary operation and maintenance manuals are acceptable to City of Thornton Project Manager and Designer.

C. Final Payment: Will be made only for products incorporated in Work; remaining products, for which partial payments have been made, shall revert to Contractor unless otherwise agreed, and partial payments made for those items will be deducted from final payment.

1.4 WORK NOT LISTED IN THE SCHEDULE OF WORK ITEMS

A. The General Conditions, Supplementary General Conditions and items in the General Requirements, Specifications and Drawings which are not listed in the schedule of work items listed in this section or the Bid Form are in general, applicable to more than one listed work item, and no separate work item is provided therefore (i.e. surveying traffic control, etc). Include the cost of all work not listed but necessary to complete the Work in accordance with the Contract Documents.

B. Contractor's bid shall establish a total cost for the Work in its entirety. Should the Contractor feel that the cost for the Work has not been established by specific items in the bid form, include the cost for that work in a related bid item so that the proposal for the project reflects the total cost for completing the Work.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 31 19 - PROJECT MEETINGS

PART 1 -- GENERAL

1.1 PROJECT REVIEW MEETING

A. Prior to the commencement of Work at the Site, a Project Review meeting will be held at a mutually agreed time and place which shall be attended by Contractor's project managers, principals, superintendents, schedulers, project engineers, and key Subcontractors as Contractor deems appropriate. Other attendees will be:

1. City of Thornton Project Manager.
2. Representatives of Owner and Designer.
3. Others as requested by Contractor, Owner, or City of Thornton Project Manager.

B. Bring to the meeting copies of the latest versions of the preliminary network diagram and preliminary tabulated schedules described in Section 01 32 16, Construction Progress Schedule.

C. The purpose of the conference is to develop a more detailed awareness of the design and design intent of the Project and schedule constraints. Project Review is an opportunity for Contractor, City of Thornton Project Manager, Designer, and Owner to review the Contract Documents and discuss Project design, schedule, construction, testing, and startup issues. The complete agenda will be furnished to Contractor prior to the meeting date. A tentative agenda of the items to be discussed is listed below.

1. Project purpose.
2. Project design.
3. Construction issues.
4. Contractor’s tentative schedules.
5. Critical Work sequencing.

D. City of Thornton Project Manager will preside at the meeting and will arrange for keeping and distributing the minutes to all persons in attendance.

1.2 PRECONSTRUCTION CONFERENCE

A. Prior to the commencement of Work, a preconstruction conference will be held at a mutually agreed time and place. The conference shall be attended by Contractor's Project Manager, its superintendent, and its Subcontractors as the Contractor deems appropriate. Other attendees will be:

1. City of Thornton Project Manager and Resident Project Representative.
2. Representatives of Owner.
3. Designer.
4. Governmental representatives as appropriate.

5. Others as requested by Contractor, Owner, or City of Thornton Project Manager.

B. Contractor shall bring the preconstruction conference submittals in accordance with Section 01 33 00, Contractor Submittals and preliminary tabulated schedules described in Section 01 32 16, Construction Progress Schedule.

C. The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The meeting is an opportunity for Contractor, City of Thornton Project Manager, Designer, and Owner to review the Contract Documents and discuss Project design, schedule, shutdown, draining, construction, testing, and startup issues. The complete agenda will be furnished to Contractor prior to the meeting date; however, Contractor should be prepared to discuss all of the items listed below.

1. Status of Contractor's insurance and bonds.
2. Contractor's tentative schedules.
3. Transmittal, review, and distribution of Contractor's submittals.
4. Processing applications for payment.
5. Maintaining record documents.
6. Critical Work sequencing.
7. Field decisions and Change Orders.
8. Use of Site, office and storage areas, security, housekeeping, and Owner's needs.
9. Major equipment deliveries and priorities.
10. Contractor's assignments for safety and first aid.
11. Daily Report Form that City of Thornton Project Manager will furnish.
12. Submittal Transmittal Form which City of Thornton Project Manager will furnish.

D. City of Thornton Project Manager will preside at the preconstruction conference and will arrange for keeping and distributing the minutes to all persons in attendance.

1.3 PROGRESS MEETINGS:

A. The purpose of the meetings is to review progress of Work, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems that may develop. During each meeting, Contractor shall present any issues that may impact its progress with a view to resolve these issues expeditiously.

B. City of Thornton Project Manager will schedule and conduct regular progress meetings at least weekly and at other times as requested by Contractor or as required by progress of the Work. City of Thornton Project Manager will arrange for keeping and distributing the minutes. Contractor, City of Thornton Project Manager, and all Subcontractors active on the Site shall attend each meeting. Contractor may, at its discretion request attendance by representatives of its Suppliers, manufacturers, and other Subcontractors. City of Thornton Project Manager will select meeting location.

C. City of Thornton Project Manager will preside at the progress meetings and will arrange for keeping and distributing the minutes. The purpose of the meetings is to review progress of Work, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems that may develop. During each meeting, Contractor shall present any issues that may impact its progress with a view to resolve these issues expeditiously.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 32 16 - CONSTRUCTION PROGRESS SCHEDULE

PART 1 -- GENERAL (NOT USED)

PART 2 -- DEFINITIONS

A. Progress Schedule: The accepted baseline schedule for the construction contract, demonstrating the planned activities, activity costs, and activity durations as the Project was bid.

B. Cash Flow: For construction costs, reflects scheduled expenditures based on activity cost loading. This is the anticipated Contractor billings (gross) before the withholding of retention, and is estimated by the Contractor.

C. Early Finish: The earliest a schedule activity is expected to finish, based on its relationship (logic) to other activities in the project.

D. Early Start: The earliest a schedule activity is expected to start, based on its relationship (logic) to other activities in the project.

E. Late Finish: The latest a schedule activity can finish, based on its relationship (logic) to other activities on the project, and still permit the project to be completed on time.

F. Late Start: The latest a schedule activity can start, based on its relationship (logic) to other activities on the project, and still permit the project to be completed on time.

G. Baseline Manpower Schedule: A schedule listing the manpower required to accomplish the work as defined in the Progress Schedule in the time frames established in the Progress Schedule.

H. Original Duration: The amount of time, in calendar days, an activity was expected to take to complete at the beginning of a project.

I. Preliminary Progress Schedule: Covers construction related activities from Notice to Proceed up through Notice to Proceed plus 90 days.

J. Total Float: The number of days by which a part of the Work in the construction schedule may be delayed from its early start/finish dates without necessarily extending the contract completion date.

K. Work Activity: An activity which requires time and resources to complete and must be performed before the Contract is considered complete.

PART 3 -- SUBMITTALS

A. Refer to Parts 5, 7, 10, 13, and 14 below.

PART 4 -- QUALIFICATIONS

A. The Contractor shall employ a trained and experienced construction scheduling person knowledgeable in construction Work sequencing, productivity, scheduling,

and application of the scheduling software system. This person, along with the Contractor's management team is expected to work closely with the City of Thornton Project Manager to deliver acceptable products outlined in this section and comply with the reporting requirements of this section.

PART 5 -- CRITICAL PATH NETWORK

A. The Critical Path Method (CPM) type construction schedule will be used to monitor job progress. The Contractor shall be responsible for providing all information concerning the sequencing, logic and duration of all activities as well as providing the initial CPM logic network (in electronic and paper form) diagram and tabular report data.

B. The CPM Logic Diagrams shall be plotter drawn CPM logic diagrams and submitted on sheets 22 inches by 36 inches or as otherwise directed by the City of Thornton Project Manager. The activity box shall include, as a minimum, the activity number, activity description, original durations and total float. Logic diagrams shall be submitted until both the Preliminary and Progress Schedules are accepted.

C. The activities contained within the schedules will be cost loaded to equal the Contract Price. Overhead and profit shall be prorated on all activities for the entire project length. The Contractor shall not unbalance the activity cost loading.

D. The Contractor shall collect data and information from Subcontractors, Suppliers, and equipment manufacturers for incorporation into the construction schedule.

E. The Work activities comprising the schedule shall be of sufficient detail to assure adequate planning and execution of the Work such that, in the judgment of the City of Thornton Project Manager, it provides an appropriate basis for forecasting, monitoring, and evaluation of the progress of the Work. Work activities shall conform to the following requirements:

1. Describe Work activities using consistent terminology such that the Work is readily identifiable for assessment of completion.
2. Subdivide the Work into activities of duration no longer than twenty working days each, except as to non-construction activities (such as procurement of materials, delivery of materials, delivery of equipment, and concrete curing) and any other activities for which the City of Thornton Project Manager may approve a longer duration.
3. The construction time as determined by the schedule from early start to late finish for any sub-phase, phase or the entire project shall not exceed the Contract times specified or shown in the Contract Documents. One day shall be the smallest time unit shown unless otherwise directed by the City of Thornton Project Manager.
4. Activities labeled "start," "continue," or "completion" will not be allowed. Lead and lag time activities will be acceptable only if the description accurately identifies such a restraint and that are realistic with respect to the scheduling and sequencing of the Work and overall control schedule of the project.
5. Show the following information for each Work activity:

a. WBS number consistent with the template provided by the City of Thornton Project Manager at a later date. The Contractor's CPM will be uploaded into a master project schedule developed and maintained by the City of Thornton Project Manager. The WBS is the basis for the master schedule and shall be the framework for the Contractor's Schedule of Values in the cost loaded schedule.

b. Performance responsibility, Subcontractor, trade code, (GEN, MECH, ELEC, CARP, PLAST, Etc.) and separate General Contractor identification.

c. Duration in calendar days (and number of shifts per calendar day as appropriate).

d. Work location code, descriptive of the physical plant area involved.

e. Cost data as described herein.

f. Coding and organization of data and schedule information in accordance with the WBS requirements.

F. The construction schedule shall contain the following milestones:

1. Notice to Proceed.
2. Mobilization.
3. Construction Start.
4. Substantial Completion.
5. Specified milestones.
6. Final Completion.

G. The schedule shall indicate the sequence and interdependency of Work activities. It shall include, but not be limited to, the following items as appropriate to this Contract:

1. Working drawing preparation by the Contractor and review by the City of Thornton Project Manager.
2. Material and Equipment (early start / finish dates, and late start / finish dates):
   a. Vendor submittal /acceptance.
   b. Shop drawing submittal /acceptance.
   c. Release for fabrication.
   d. Fabrication period.
   e. Witness shop test (if applicable).
   f. Delivery.
   g. Installation.
   h. Check out.
   i. O&M manuals submittal /acceptance.
   j. Lesson plans submittal /acceptance.
   k. Training.
3. Shop and field performance tests and supervisory service activities.

4. Mobilization and move in.
5. Preparing coordination and layout drawings.
6. Environmental constraints as indicated in the Contract Documents.
7. Obtaining all required permits.
8. Specific Work activities including, but not limited to: sitework, excavation, underground pipe installation, structural excavation, soil testing, backfill, placement of sheeting, pile driving, formwork erection, rebar placement, placing of concrete, stripping forms, concrete curing, installation of fiber optic conduits, terminations, other materials and equipment, revegetation, and cleanup.
9. Construction of all facilities outlined in the Contract Documents.
10. Subcontractor's items of Work.
11. Time allowance for inclement weather per National Oceanic and Atmospheric Administration (NOAA) information.
12. Punchlists.
13. Final cleanup.
14. Time allowance for testing.
15. Contract activity interface coordination with other contractors, substantial completion and final completion dates, and maintaining operations of existing plant(s).
16. Indicate all coordination activities from related Construction Contracts.
17. Connection to all existing plant systems and equipment.
18. Preparation of final copies of Contractor working drawings.
19. Specific information required by the City of Thornton Project Manager.
20. All temporary utilities and construction.
21. Required inspections by the City of Thornton Project Manager.
22. Monthly updating of Contract Record Drawings and final submittal of Record Drawings at project completion, or as directed by the City of Thornton Project Manager.

H. The schedule database must be organized and coded in accordance with the work breakdown structure (WBS) template which will be supplied to the Contractor by the City of Thornton Project Manager at a later date. The Contractor’s CPM will be uploaded into a master project schedule developed and maintained by the City of Thornton Project Manager. The WBS is the basis for the master schedule and shall be the framework for the Contractor’s Schedule of Values in the cost loaded schedule.

I. Develop other activity codes and values needed to comply with the reporting requirements listed herewith, subject to acceptance by the City of Thornton Project Manager.

PART 6 -- TIME EXTENSION FOR SEVERE WEATHER

A. Upon written request from the Contractor, the Project Manager may suspend the counting of contract time, herein called time extension, for the Contractor's convenience during unusually severe weather. The Contractor's request for time extension due to severe weather delays shall clearly demonstrate that the weather conditions are "unusually severe," would not have been reasonably anticipated given the normal prevalent weather conditions in the locality of the work, that such conditions adversely affected 50 percent or more of the Contractor's workday and delayed work critical to the timely completion of the project.

B. “Unusually severe” weather conditions are defined as:

1. Sustained air temperature at the job site for more than 4 hours during the Working Hours that is at least 10 degrees Fahrenheit below the temperatures listed below:

2.

Temperature (degrees Fahrenheit)			
DEC	JAN	FEB	MAR
17	15	19	25

3. Rainfall at the job site greater than 0.5 inches per hour.
4. Snowfall at the job site greater than 10 inches in a single occurrence.
5. Sustained winds for 2 hours or longer at the job site of greater than 35 miles per hour.

C. The Contractor is reminded that the contract time already includes an allowance for calendar days lost to adverse weather for each month. The anticipated number of days lost is based on the current standard used by the Urban Drainage and Flood Control District, and is listed as follows:

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
7	4	4	4	6	3	4	2	3	3	4	5

D. Only the number of days lost due to unusually severe weather as requested by the Contractor and approved by the City of Thornton Project Manager, that exceeds the above-anticipated number of days lost for the month, shall be considered for granting a contract time extension.

E. If, at any time during the contract time period, the Contractor fails to prosecute the work continuously and diligently as reasonably expected, and with sufficient forces and equipment to maintain satisfactory work progress, the Contractor shall forfeit the right to time extension for unusually severe weather conditions. In this case, the Contractor shall make up for the time lost through acceleration of the remaining work and without any additional costs to the City.

F. The time extension will be implemented by change order. All costs resulting from the time extension including, but not limited to, the protection and maintenance of the job site, maintaining specified insurance and bonding certificates, and traffic control for the period of time extension, shall be the responsibility of the Contractor and at no

additional cost to the City. Unit price adjustments or special allowances shall not he paid by the City for escalated material, labor, equipment, or any other costs associated with the time extension.

PART 7 -- PRELIMINARY PROGRESS SCHEDULE

A. The Preliminary Progress Schedule (which is due no later than 10 business days after Notice to Proceed) shall contain 10 copies of the following information:

1. All procurement activities such as: prepare submittals/shop drawings, City of Thornton Project Manager's review and comment, fabrication and delivery, and shop testing.
2. The project's critical path.
3. Each building and/or areas major sequences of Work.
4. Cash flow report for the total project.
5. All procurement activities, including testing.
6. Scheduled activities for the period of Notice to Proceed up to 90 days thereafter.

PART 8 -- PROGRESS SCHEDULE

A. The Progress Schedule (which is due no later than 60 days after Notice to Proceed) shall demonstrate the final level of detail for each activity and shall contain the required relationships completely identified and the durations of each activity correctly depicted. The Progress Schedule shall be composed of <u>two parts</u>:

1. A complete logic and duration schedule at the final level of detail for each activity, containing the required relationships completely identified and the durations of each activity correctly depicted.
2. The Progress Schedule shall contain no Contract changes or delays which may have been incurred during the interim schedule development period. These changes will be entered at the first update after the Progress Schedule has been accepted.
3. The Progress Schedule will contain all cost information assigned each of the specific activities at the final level of detail. Each activity shall be cost loaded to permit initial and monthly generation of a cash flow curve and resource curve and to assess the progress of the Work.
4. If the Progress Schedule is not accepted, the Contractor shall revise the schedule in accordance with the City of Thornton Project Manager's comments and resubmit within 14 calendar days.
5. Once the Progress Schedule is accepted it becomes the schedule of record and the basis for future schedule updates.
6. After the acceptance of the Progress Schedule, no changes shall be made therein without approval of the City of Thornton Project Manager.
7. The Contractor shall not be entitled to any damages by reason of the failure of the City of Thornton Project Manager to give timely acceptance or comments on any progress schedule hereunder.

B. Contractor's first payment request will be processed if the Progress Schedule has been submitted by the Contractor and returned by the City of Thornton Project Manager with corrections noted with the understanding that the corrections will be made.

C. Contractors second payment request will be processed for payment only if the Progress Schedule has been submitted by the Contractor and returned by the City of Thornton Project Manager with corrections noted with the understanding that the corrections will be made and that the final corrected version is received within 60 days from Notice to Proceed.

D. As a condition precedent to payment of the Contractor's third payment request thereafter for costs earned under the Contract, the Progress Schedule must be acceptable to the City of Thornton Project Manager.

PART 9 -- MANPOWER SCHEDULE

A. Contractor shall provide a baseline Manpower Schedule along with the Construction Progress Schedule. The baseline Manpower Schedule shall be a matrix of time and craft including all craft leadership and support staff. Any proposed changes to the baseline Manpower Schedule may only be made with the acceptance of the City of Thornton Project Manager. All updated version(s) of the Manpower Schedule shall be submitted with the pay application along with the Construction Progress Schedule on a monthly basis.

PART 10 -- PROGRESS OF THE WORK

A. If at any time during the project, the Contractor fails to complete any activity by its latest completion date, he will be required, within 7 days, to submit to the City of Thornton Project Manager a written statement as to how and when he plans to reorganize his work force and re-schedule the Work and recovery and potential schedule delay during the next schedule update period.

B. Monthly Schedule Updates:

1. Once the Baseline Progress Schedule is accepted by the City of Thornton Project Manager, the Contractor shall be responsible for preparing and submitting monthly update information on logic, physical percent complete, actual start and finish dates, and duration changes and related reports, diagrams and schedules.

2. All subsequent monthly updates shall be compared to the Baseline Progress Schedule. In addition, each current monthly update shall be compared to the last month's update. Each update shall be labeled by period with data date and report date identified on the hard copy and electronic file label.

3. The monthly update of the Baseline Progress Schedule shall include the following:

   a. Two electronic copies of the schedule, data date and monthly period clearly marked.

   b. Two copies of the CPM computer printout and arrow diagram which shall:

1) Compare baseline schedule activities against current update activities.
2) Clearly identify critical path and near critical paths.

c. Two electronic and two hard copies of the narrative report.

d. Two electronic and two hard copies of the cash flow projections by month with early and late forecast schedule dates and actual partial payment amounts by Contractor and total project.

e. Two electronic and two hard copies of successor / predecessor, total float and 90 day look ahead reports.

f. Two electronic and two hard copies of the detailed monthly cost activity report, reflecting the actual costs for the period, costs to date, and budgeted costs.

g. Two electronic and two hard copies of the monthly summary cost activity report, oriented to the monthly payment requisition level of detail.

h. Two electronic and two hard copies of the updated resource report.

4. Updates shall be provided monthly with the request for progress payment. The City of Thornton Project Manager shall have the right to withhold payment until the monthly update(s) have been received. Updates to the schedule shall begin immediately following acceptance of the Preliminary Schedule. Updates will continue during the development of the baseline schedule. Once the baseline schedule is found to be acceptable, it shall become the basis for succeeding schedule updates.

5. Default progress data provided from the scheduling system shall not be allowed. Actual start and finish dates shall not be automatically updated by default mechanisms that may be included in CPM scheduling software systems. Actual start and finish dates on the CPM schedule shall match those dates provided from the Contractor Daily Control Reports represent that the actual dates are accurate. Failure of the Contractor to document the actual start and finish dates on the Contractor Daily Control Report for every in-progress or completed activity and to ensure that the data contained on the Contractor Daily Control Reports is the sole basis for schedule updating shall result in the disapproval of the Contractor's schedule and the inability of the City of Thornton Project Manager to evaluate the Contractor progress for payment purposes.

6. Activities that have reported progress without predecessor activities being completed (Out-of-Sequence Progress) will not be allowed except on a case-by-case basis with the approval from the City of Thornton Project Manager. A written explanation of each activity shall be included in the monthly submittal. The City of Thornton Project Manager may direct that changes in schedule logic be made to correct any or all out-of-sequence Work.

7. The Contractor shall identify each month any changes to the schedule, such as: new activities, deleted activities, activity duration changes, activity description changes, and change in logic relationships between activities. Logic changes shall be described, with an explanation of the rational for the change provided in the report.

8. The Contractor shall not constrain the schedule with artificial logic ties and or constraint dates and or any other scheduling techniques that may distort the

activity float and total float associated with the critical path activities and the schedule in general.

9. The Contractor shall provide a schedule defining the times at which equipment, materials, means and methods which require submittals. This submittal schedule shall be tied to early start / early finish and late start / late finish dates to ensure that time has been allowed for review and return.

10. The Contractor shall submit monthly the proposed correlated sequence and estimated dates for submission, approval and final submission activities for the following:
    a. Working Drawings Submittals.
    b. Equipment operation and maintenance manuals submittals.
    c. Delivery of materials and equipment to site.
    d. Final field tests.
    e. Special tools and lubricant deliveries.
    f. Spare part deliveries.
    g. Instructional services.
    h. Permits
    i. Final Record Documents
    j. Testing
    k. Piping and Equipment Identification
    l. The above information shall be presented, in an organized tabular format, showing each submittal item:
        1) Submission date (actual or forecast)
        2) Approval date (actual or forecast)
        3) Final submissions (actual or forecast)
        4) Comments (actual or forecast)

    m. The above equipment/material information shall be presented in an organized tabular matrix format, showing for each item:
        1) Drawing submittal date (actual or forecast)
        2) Drawing approval date (actual or forecast)
        3) Release for fabrication date (actual or forecast)
        4) Delivery date (actual or forecast)

PART 11 -- COST AND NARRATIVE PROGRESS REPORTS

A. Prepare and submit a detailed and summary cost activity reports each month. The cost information shall be updated by activity and summarized for each month. The sum of all monthly costs shall be equal to the contract amount plus approved change orders. The updated cost information shall be consistent with the payment amounts requested via the payment requisition.

B. The costs shall be summarized for each month and the sum of all the monthly costs shall be equal to the Contract Price.

C. The Narrative Report shall include and be in the following format:

1. The Contractor's transmittal letter.
2. Schedule report indicating each activity on the CPM Schedule that it has been:
    a. Completed during this reporting period.
    b. In progress this reporting period.
    c. Scheduled next reporting period.
3. Analysis, by critical path, of each negative path describing:
    a. The nature of the critical path.
    b. Impact on other activities, milestones and completion dates.
    c. Recommendations for recovery of the delays.
4. Current and anticipated delays.
    a. Cause of the delay.
    b. Corrective action and schedule adjustments to correct the delay.
    c. Impact of the delay on other activities, milestones and completion dates.
5. Change in construction sequence, logic changers, relationship changes or duration changes and the rationale associated with each change that required the change to be made.
6. Pending issues and status of other items:
    a. Permits.
    b. Contract modifications.
    c. Time extension requests.
    d. Long lead procurement items.
7. Tabular schedule reports tabulated by:
    a. Contractor/early start.
    b. Total float/early start.
    c. Area/early start.
    d. Activity number.
8. Added/deleted activities.
9. Out of Sequence Report describing the necessity of each activity relationship shown therein.
10. Illogical Progress/Restraint Reports (if any).
11. Contract complete date status.
12. Ahead of schedule and number of days.
13. Behind schedule and number of days.
14. Summary of project cost data by appropriate breakdown including budget quantity, cost, percent complete, actions to date, actions this period, estimate to complete and variance.

15. Summary of project status including cumulative information to date, variance and forecast at completion.
16. Other project or scheduling concerns.
17. Review and update of CPM Schedule.
18. Safety Reports and any code violations or warnings.
19. Computer disk containing the latest CPM schedule update file.

PART 12 -- SCHEDULE END FLOAT

A. Total Float is the number of days by which a part of the Work in the construction schedule may be delayed from its early start and finish dates without necessarily extending the contract completion date. The difference in time between the project's scheduled early completion date, as submitted, and the required contract completion date shall be considered as float. Float within the overall schedule, and total float within the overall schedule, is not for the exclusive use of either the Owner or the Contractor, but is jointly owned by both parties and is a resource available to be shared by both as needed to meet Contract milestones and the contract completion dates.

B. The Contractor shall not sequester shared float though such strategies as extending activity duration estimates to consume available float, using preferential logic, using extensive crew/resource sequencing, etc. Since float time within the schedule is jointly owned, no time extensions will be granted or delay damages paid until the critical path of the CPM schedule is affected with extends the Work beyond a milestone or contract completion date.

C. Early completion schedules are generally not acceptable to the Owner but may accepted as convenience to the Contractor under the following conditions.

1. The Contractor must submit a written request outlining the specific reasons for using the early completion schedule.
2. The Contractor acknowledges and agrees in writing that the proposed reduction in time represents Project time already paid for by the Owner as part of the Bid Price, and is available to both the Contractor and the Owner for mitigation of impacts to the Project form any source. The Contractor shall not be entitled to any increase in Contract Price for failure to achieve the early completion and the Contractor waives all claims to same.
3. Early completion schedule shall not be based on expedited approvals, inspection, or the relaxing of construction constraints by the Owner, City of Thornton Project Manager or the Designer.
4. Early completion schedules must meet all other Contract requirements.
5. The Contractor acknowledges and agrees in writing that the Owner has the right to withhold the final payment due the Contractor until the contractual end date.
6. Early completion schedule updates which contain activities behind schedule shall be revised when requested by the City of Thornton Project Manager.

PART 13 -- THREE WEEK LOOK AHEAD

A. The Contractor shall provide a three week look ahead schedule which shall include the week in which the schedule is presented, plus the two successive weeks thereafter. The three week look ahead shall be submitted to the City of Thornton Project Manager no later than 48 hours prior to the weekly project progress meeting.

PART 14 -- WEEKLY PROGRESS MEETING AND REPORTS

A. Once each week on a date established by the City of Thornton Project Manager, a progress meeting will be held at which time the schedule will be reviewed. The meeting shall be attended by the City of Thornton Project Manager, design engineering consultants, Contractor, and Subcontractor representatives for this Contract. See Specification 01 31 19 Project Meetings for additional details and submittal information.

B. The Contractor's representative(s) at the meetings shall have the competence and authority to make any necessary decisions and their statement shall commit the Contractor to the agreed procedures, sequence of Work activities, operations and time schedules.

C. The updated Schedule shall be furnished to the City of Thornton Project Manager electronically at least 48 hours prior to the meeting and be available in hard copy at the meeting for review. To update the CPM Schedule, the Contractor shall:

1. Obtain from each Subcontractor the necessary information to update the schedule to reflect progress to date and to update the schedule for the balance of the project.
2. Enter actual start and completion dates for those activities started and/or completed during the previous reporting period.
3. For activities in progress, indicate the remaining duration correlating to an accurate forecasted completion date and physical percentage complete to date. Review and revise as necessary the network logic for the remaining duration of the Work from the update to the estimated completion date.
4. For activities not yet started, review and revise as required the necessary logic for the durations and the estimated start and completion dates.
5. Enter for each applicable activity, actual installed quantities information and corresponding cost information.
6. Add identified contract modification activities.
7. Annotate updated status information on the CPM Schedule in a manner that graphically depicts the current status of the Work.
8. Should discrepancies regarding data/information accuracy be noted during the review meeting or other discussions, the City of Thornton Project Manager may direct the Contractor to adjust the percentage complete, and remaining duration, and actual dates to selected activities and re-issue the updated schedule and cost reports.

D. Failure to submit the schedule, subsequent updates, or previously requested corrections of the schedule within seven calendar days of the update meeting, shall be considered cause for withholding any partial payments due or that may become due under the Contract.

E. These reports shall be generated from the Contractors scheduling database and other software tools to comply with the report examples provided herein. In addition, the Contractor shall work closely with the City of Thornton Project Manager to produce the final reports subject to approval by the City of Thornton Project Manager.

PART 15 -- REMEDIAL MEASURES AND RECOVERY SCHEDULE

A. Delays to Critical Path Whenever it becomes apparent from the current monthly update that delays to the critical path have resulted and these delays are through no fault of the Owner or Engineer and hence, that the Contract completion date will not be met, or when so directed by the City of Thornton Project Manager, the Contractor shall take some or all of the following actions at no additional cost to the Owner:

1. Increase resources in such quantities and crafts as will substantially eliminate the backlog of Work.
2. Increase working hours per shift, shifts per day, or working days per week, the amount of construction equipment, or any combination of the foregoing to substantially eliminate the backlog of Work.
3. Reschedule activities to achieve maximum practical concurrence of accomplishment of activities, and comply with the revised schedule.

B. The Contractor shall submit to the City of Thornton Project Manager for review a written statement of the steps he intends to take to remove or arrest the delay to the schedule. The Contractor shall promptly provide such level of effort to bring the Work back on schedule. Should schedule delays persist, the Contractor's surety may be asked to attend schedule update meetings.

C. Under no circumstances will the addition of equipment, construction forces, increasing the working hours, any other method, manner, or procedure to return to the CPM Schedule be considered justification for contract modification or extra Work.

D. Failure of the Contractor to recover the Schedule time frames as set forth in this agreement will be considered to be a material breach of the Contract. Thereupon the Owner shall have the right to remove any or all of the remaining Work from the Contractor's scope and to complete such Work, by whatever method the Owner may deem expedient, including employing another contractor or contractors under such form of contract as the Owner may deem advisable, or the Owner may itself provide all labor or materials and perform any part of such Work at its option. The Contractor agrees that the Owner shall have the right to take possession of and to use any or all of the materials, plant, tools, goods, supplies and property of any and every kind furnished by the Contractor for such Work. The expense of so completing such Work, together with a reasonable charge for administering any contract for such completion, shall be charged to the Contractor, and such expense shall be deducted by the Owner out of such monies as may be due or may at any time thereafter become due to the Contractor. In case such expense exceeds the sum which would

have otherwise been payable under the Contract, then the Contractor and it sureties shall be liable for and shall upon notice from Owner, promptly pay to the Owner the amount of the increase in cost of doing the Work.

E. The City of Thornton Project Manager may require the Contractor, at any time during the project, to develop a more detailed schedule/fragment than depicted in the detailed schedule, to provide a clearer understanding of the effort needed to complete a specific area or task.

PART 16 -- PAYMENT DEDUCTIONS

A. A permanent line-item deduction, at the pro-rata rate of two thousand dollars per month shall be deducted from the Contract Price if, in the judgment of the City of Thornton Project Manager, Contractor is deemed to be the cause for the delay in submitting any of the three aforementioned submittals or subsequent monthly updates per monthly progress meetings and Reports. The Contractor shall be notified within one week of said delinquency that the permanent deduction is being assessed against the Contract.

PART 17 -- FLOAT OWNERSHIP

A. Without obligation to extend the overall completion date or any intermediate completion dates set out in the CPM schedule, the City of Thornton Project Manager may initiate changes to the Contract Work that absorb float time only. Contractor-initiated changes that encroach on the float time identified in the CPM schedule may be accomplished with the City of Thornton Project Manager's approval.

B. Owner-initiated changes that extend or shorten the Contract Times shall be the sole basis to adjust the Contract completion date. Delays in the critical path not associated with proper requests for time extensions in accordance with the General Conditions shall be deemed to be the responsibility of the Contractor.

PART 18 -- PRODUCTS (NOT USED)

PART 19 -- EXECUTION (NOT USED)

- END OF SECTION -

City of Thornton
Standley Lake Pipeline Access
List of Submittal Requirements
Date Updated: 8/17/2020

Submittal Section No.	Submittal Title	Contractor Submittal Requirements
		Division 01 - General Requirements
01 14 16	Public and Media Relations	☐ Emergency Notification Key Contacts ☐ Public Notification
01 29 76	Price and Payment Procedures	☐ Schedule of Estimated Progress Payments ☐ Application of Payment ☐ Final Application of Payment
01 32 16	Construction Progress Schedule	☐ Refer to Appendix A
01 33 00	Contractor Submittals	☐ Electronic Submittals Required
01 33 50	Site Conditions Surveys and Construction Progress Documentation	Action Submittals: ☐ Qualifications of video survey subcontractor ☐ Documentation survey plan including route ☐ DVD's and logs of first day's site conditions surveys Informative Submittals: ☐ A copy of video surveys, photographs and narrative logs ☐ Compact disc file of construction progress photographs (submitted weekly) ☐ Post-construction topography mapping ☐ Set of compact discs of all photographs, mapping and survey data ☐ Post-construction condition survey documentation
01 33 51	Project Record Documents	☐ Record Drawings
01 35 29	Health and Safety	Submit a copy of: ☐ Safe Work Plan ☐ Emergency Plan ☐ Rigging and Hoisting Plans ☐ Excavation and Trenching Plans ☐ Respiratory Protection Program ☐ Fire Protection Plan ☐ Safety Plan and Hazard Protection Program ☐ Hazard Analysis Prior to Major Activities ☐ Confined Space Entry Program ☐ Electrical Safety ☐ Lock Out/Tag Out ☐ Fall Protection ☐ Heavy Equipment Operations ☐ Burying and Welding Operations ☐ Training Plan ☐ Project Rules and Regulations ☐ Material Handling ☐ Fuel Storage and Refueling ☐ Hazard Communication Program ☐ Personal Protective Equipment ☐ Traffic Control ☐ Environmental Controls ☐ Security ☐ Drug Testing ☐ Safety Meetings ☐ Spill Control Plan ☐ First Aid Facilities ☐ Qualifications of the Safety Representative ☐ Material Safety Data Sheet (MSDS) ☐ Scope of Work Job Safety Analysis (JSA)
01 35 53	Site Security	☐ Submit security plan
01 45 00	Quality Assurance - Quality Control	☐ Qualifications of the Contractor's QA/QC Representative ☐ Contractor's Quality Assurance/Quality Control Plan ☐ Contractor's Daily Quality Control Report ☐ Daily Inspection Report
01 55 00	Site Access and Storage	☐ EPA number for wastes generated
01 55 26	Traffic Control	☐ Administrative Submittals ☐ Shop Drawings: Approved Traffic Control and Routing Plans & Message Boards ☐ Traffic Control Supervisor(s) Qualifications
01 57 19	Temporary Environmental Controls	☐ Removal, mitigation, and remediation of any contaminated soils or water ☐ Environmental Protection Plan (EPP)
		Division 02 - Existing Conditions
02 21 13	Site Preparation	☐ Approved paint for tree removal ☐ Topsoil Plan
02 81 00	Irrigation System	☐ Material List
02 90 00	Landscape Installation	☐ Five (5) Copies of all product data sheets, cut sheets or test results and two (2) samples of all materials specificed ☐ Material List

City of Thornton
Standley Lake Pipeline Access
List of Submittal Requirements
Date Updated: 8/17/2020

Submittal Section No.	Submittal Title	Contractor Submittal Requirements
		Division 03 - Concrete
03 30 00	Cast-in-Place Concrete	☐ Reports of concrete mix designs ☐ Copies of Manufacturers data ☐ Three copies of reports from the concrete supplier ☐ Delivery ticket of each load of ready-mixed concrete delivered to the job site ☐ Reinforcement placing drawings ☐ Certified mill test reports for the reinforcement supplied
		Division 05 - Metals
05 05 13.01	Shop-Applied Coatings for Metal - Zinc	☐ Manufacturer's Data Showing Conformance ☐ Manufacturer's Recommendation for Application of Zinc Dust-Zinc Oxide Coating ☐ Coating applicator's Certificate of Compliance
05 12 00	Structural Steel Framing	☐ Shop Drawings showing materials, fabrication details, mark numbers, connections, and dimensions.
05 50 00	Metal Fabrications	☐ Manufacturer's catalog and product data
		Division 09 - Finishes
09 90 04	Painting	☐ Shop Drawings ☐ Samples of paint, finishes, and other coating materials specified herein ☐ Minimum of one 4" x 4" steel sample panel, for each Sandblast grade to be used on the project ☐ Coating materials list that indicates the manufacturer and coating number, keyed to the coating systems herein Submit 30 days prior to painting: ☐ Data sheet for each product used including the suitability of the material for the intended use ☐ Instructions and recommendations on surface preparation and application ☐ Colors available for each product (where applicable) ☐ Compatibility of shop and field applied coatings (where applicable) ☐ Material Safety Data Sheet for each product used ☐ Two sets of color samples to match each color selected by the ENGINEER from the manufacturer's standard color sheets Manufacturer's Certification: ☐ The manufacturer's representative has provided at least 6 hours of on-site instruction in the proper surface preparation, use, mixing, application, and curing of the coating systems ☐ The manufacturer's representative has personally observed the start of surface preparation, mixing, and application of the coating materials ☐ That surface preparation and coatings are in conformance with these Specifications. ☐ Provide coating material data sheet Proposed Substitutions: ☐ 10 installations of similar service conditions that the proposed substitute product has shown satisfactory performance for at least several years ☐ Include owner's contact name, address, and phone number of each installation ☐ Quality ☐ Durability ☐ Resistance to abrasion and physical damage ☐ Life expectancy ☐ Ability to recoat in future ☐ Solids content by volume ☐ Dry film thickness per coat ☐ Compatibility with other coatings ☐ Suitability for the intended service ☐ Resistance to chemical attack ☐ Temperature limitations in service and during application ☐ Type and quality of recommended undercoats and topcoats ☐ Ease of application ☐ Ease of repairing damaged areas ☐ Stability of colors
09 97 13.03	Steel Coatings - Polyurethane	☐ Shop Drawings ☐ Coating Materials List ☐ Materials Information ☐ Samples

City of Thornton
Standley Lake Pipeline Access
List of Submittal Requirements
Date Updated: 8/17/2020

Submittal Section No.	Submittal Title	Contractor Submittal Requirements
		Division 26 - Electrical
26 42 00	Cathodic Protection	☐ Product Data ☐ Quality Control
		Division 31 - Earthwork
31 23 00	Earthwork: Excavation and Fill	☐ Certification of qualified individual designing the sheeting/shoring and trench support systems ☐ Submit samples of materials ☐ Means, methods and material specification for backfilling
31 25 00	Soil Surface Erosion Control	☐ Certificate with each delivery stating source, quantity and type of material ☐ Project Review
31 50 00	Excavation Support and Protection	☐ Information required by OSHA as Product Data
		Division 32 - Exterior Improvements
32 12 16	Asphalt Pavement	☐ Source of materials ☐ Gradation, specific gravity, source and description of individual aggregates and the final blend ☐ Aggregate physical properties ☐ Source and Grade of Performance Graded Binder ☐ Proposed Job Design Mix ☐ Mixing and compaction temperatures used ☐ Mixture properties ☐ Suitability Tests of Proposed Materials ☐ Trial Batch
32 90 00	Revegetation	☐ Certificate of Inspection ☐ Signed statements certifying origin of seed ☐ Seed tags and recalculated seed mixes ☐ Sod supplier's test reports and information
		Division 33 - Utilities
33 05 13	Manholes, Vaults and Structures	☐ Shop drawings, product data, materials of construction and details of installation ☐ Design Data ☐ Test Reports
33 11 01.01	Steel Pipe	☐ Shop Drawings in accordance with ANSI/AWWA requirements ☐ Certifications
33 11 01.03	Steel Pipe - Fabricated Specials	☐ Shop Drawings ☐ Fittings and specials details with design calculations ☐ Certifications
33 12 00	Water Utility Distribution Equipment	☐ Shop drawings Valve Submittal Requirements: ☐ Valve name, size, parts, materials, valve coefficient (Cv), pressure rating, identification number (station) and specification section number ☐ Valve actuator including size, manufacturer, model number, and mounting. Manufacturer calculations in sizing operators. ☐ Assembly drawings showing relationship of valve handles, handwheels, stem extensions, and operating nuts. ☐ Lining and coating product literature. ☐ A tabular valve schedule indicating the station and model number of proposed valve to be installed at each station including, direction to turn open, pressure rating classification, nominal size, operator orientation, operator type, actuator turndown ratio, and number of turns to close ☐ Manufacturer certified material and pressure test performance reports.

SECTION 01 33 00 - CONTRACTOR SUBMITTALS

PART 1 -- GENERAL

1.1 GENERAL

A. Wherever submittals are required in the Contract Documents, submit them to City of Thornton Project Manager.

B. Contractor shall be responsible for the accuracy, completeness, and coordination of submittals. Contractor shall not delegate this responsibility in whole or in part to any Subcontractor. Submittals may be prepared by Contractor, Subcontractor, or Supplier, but before submitting it, Contractor shall ascertain that each submittal meets the requirements of the Contract and the Project. Contractor shall verify that there is no conflict with other submittals and shall notify City of Thornton Project Manager in each case where Contractor's submittal may affect the work of another contractor or the Owner. Contractor shall coordinate submittals of related crafts and Subcontractors.

1.2 ELECTRONIC SUBMITTALS REQUIRED

A. Unless specifically accepted in this specification, by City of Thornton Project Manager or elsewhere in the Contract Documents, each submittal shall be made in an electronic format.

B. Submittals shall be emailed to the City of Thornton Project Manager. If the file size is too large, contractor is responsible for setting up a File Transfer Protocol (FTP) site.

C. Samples shall be submitted via hard copy as described in this section and using the Electronic Document Management System form provided. Other submittals that include large format drawings or very lengthy documents may be considered by the City of Thornton Project Manager for hardcopy distribution. Hardcopy submittals, except for material samples, will not be accepted by the City of Thornton Project Manager without prior approval.

D. Each submittal will be an electronic file in the Adobe Acrobat Portable Document Format (PDF). Use the latest version available at the time of execution of the Agreement. Electronic files which contain more than 10 pages in Adobe Acrobat format shall contain internal book-marking from an index page to major sections of the document. PDF files shall be set to open “Bookmarks and Page” view. General information shall be added to each PDF file, including Title, Subject, Author, and Keywords. Adobe 7.0 or higher is required.

1. PDF files shall be unsecured, unencrypted and not password protected
2. The following actions within Adobe Acrobat shall be allowed:
    a. Printing
    b. Changing
    c. Assembling
    d. Content copying or extraction
    e. Extraction for Access

f. Commenting
g. Fitting of form fields
h. Signing
i. Creation of duplicate information

E. The PDF files shall be set up to print legibly at either 8 1/2 inch by 11 inch, 11 inch by 17 inch or 22 inch by 34 inch paper sizes. No other paper sizes will be accepted.

F. New electronic files shall be required for each re-submittal.

G. City of Thornton Project Manager will reject any submittal that is not electronically submitted.

H. Contractor shall provide the Designer/City of Thornton Project Manager with the authorization to reproduce and/or redistribute each file as many times as necessary for the project.

I. Contractor shall include all costs for preparation of electronic and hard copies of the submittal material in its bid, including all re-submittals, record copies, and final copies.

1.3 SCHEDULE OF SUBMITTALS

A. Refer to Articles 2.05 and 2.06 of the General Conditions for submission of the preliminary and final versions of the Contractor's Schedule of Submittals.

B. The Schedule of Submittals (list) shall be compiled using Microsoft Excel scheduling software.

C. The submittal schedule shall contain all submittals required by the Contract Documents as well as any additional submittals that Contractor or Subcontractors may know to exist or wish to include. Contractor's submittal schedule shall include all Subcontractor submittals.

D. The submittal schedule shall allow as steady of a rate of submittals as possible. Long lead items shall be submitted as early as possible.

E. List of Anticipated Submittals can be found in Attachment A.

1.4 PRECONSTRUCTION CONFERENCE SUBMITTALS

A. At the preconstruction conference, Contractor shall submit and discuss the following items:

1. The preliminary Schedule of Submittals.
2. A list of permits and licenses Contractor shall obtain, indicating the agency required to grant the permit, the expected date of submittal for the permit, and required date for receipt of the permit.
3. Preliminary and detailed Schedule of Values in accordance with General Conditions.

4. Overall project schedule.
5. The names and qualifications of the Designated Safety Representative and Designated Competent Persons.
6. A list of equipment and labor rates.

1.5 SHOP DRAWINGS

A. Wherever Shop Drawings are called for in the Contract Documents or where required by City of Thornton Project Manager, Contractor shall furnish electronic submittals in Adobe Acrobat Portable Document Format (PDF) as described in this section.

B. Shop Drawings may include detailed design calculations, shop-prepared drawings, fabrication and installation drawings, erection drawings, lists, graphs, catalog sheets, data sheets, and similar items. If Contractor is required to submit design calculations as part of a submittal, such calculations shall bear the signature and seal of an engineer registered in the appropriate branch and in Colorado, unless otherwise indicated.

C. Organization

1. A single submittal transmittal form shall be used for each technical specification section or item or class of material or equipment for which a submittal is required. A single submittal covering multiple specification sections will not be acceptable, unless the primary section references other sections for components.
2. On the transmittal form, index the components of the submittal and insert tabs in the submittal to match the components. Relate the submittal components to specification section paragraph and subparagraph, Drawing number, detail number, schedule title, room number, or building name, as applicable.
3. Unless indicated otherwise, terminology and equipment names and numbers used in submittals shall match those used in the Contract Documents.

D. Format:

1. Minimum sheet size shall be 8-1/2 inches by 11 inches. Maximum sheet size shall be 22-inches by 34-inches.
2. On the transmittal form, index the components of the submittal and insert tabs into the submittal to match the index.
3. Every page in a submittal shall be numbered in sequence. Each copy of a submittal shall be collated and stapled or bound, as appropriate. The City of Thornton Project Manager will not collate sheets or copies.
4. Where product data from a manufacturer is submitted, clearly mark which model is proposed, with complete pertinent data capacities, dimensions, clearances, diagrams, controls, connections, anchorage, and supports. Sufficient level of detail shall be presented for assessment of compliance with the Contract Documents.

a. Disorganized submittals that do not meet the requirements of the Contract Documents will be returned without review.

b. Time for review will commence from the date of receipt by the City of Thornton Project Manager for each submittal received by 12:00 noon Mountain Standard Time (MST) on any work day. For submittals received after 12:00 noon MST, the time for review will commence on the following work day.

c. City of Thornton Project Manager will return comments or scans of each submittal to the Contractor with comments noted thereon.

d. It is considered reasonable that the Contractor will make a complete and acceptable submittal to the City of Thornton Project Manager by the first resubmittal on an item. The Owner reserves the right to withhold monies due to the Contractor to cover additional costs of the City of Thornton Project Manager's and Designer's review times beyond the first resubmittal.

e. The maximum review period for each submittal or resubmittal will be 30 Days. Thus, for a submittal that requires 2 resubmittals before it is complete, the maximum review period could be 90 Days.

f. If a submittal is returned to the Contractor marked "REVIEWED – NO EXCEPTIONS," formal revision and resubmission will not be required. Contractor may incorporate the products or implement Work covered by the submittal.

g. If a submittal is returned marked "REVIEWED – EXCEPTIONS NOTED," Contractor may incorporate the products or implement the Work covered by the submittal and implement it according to the Designer's notations, but formal revision and resubmission will not be required.

h. If a submittal is returned marked "REVISE AND RESUBMIT," the Contractor shall not incorporate the products or implement the Work covered by the submittal, but shall revise it and shall resubmit. Resubmittal of portions of multi-page or multi-drawing submittals will not be allowed. For example, if a Shop Drawing submittal consisting of 10 drawings contains one drawing noted as "REVISE AND RESUBMIT," the submittal as a whole is deemed "REVISE AND RESUBMIT," and 10 drawings are required to be resubmitted.

i. If a submittal is returned marked "REJECTED," Contractor shall not incorporate the products or implement the Work covered by the submittal. Either the proposed material or product does not satisfy the specification, the submittal is so incomplete that it cannot be reviewed, or it is a substitution request not submitted in accordance with the General Conditions. In the first 2 cases, the Contractor shall prepare a new submittal and shall submit the required number of copies. In the latter case, the Contractor shall submit the substitution request according to the General Conditions.

j. Resubmittal of rejected portions of a previous submittal will not be allowed. Every change from a submittal to a resubmittal or from a resubmittal to a subsequent resubmittal shall be identified and flagged on the resubmittal.

k. Fabrication of an item may commence only after City of Thornton Project Manager has reviewed the pertinent submittals and returned copies to

Contractor marked either "REVIEWED – NO EXCEPTIONS" or "REVIEWED – EXCEPTIONS NOTED." Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as changes to the contract requirements.

l. Submittals shall be carefully reviewed by an authorized representative of Contractor prior to submission to City of Thornton Project Manager. Each submittal shall be dated and signed by Contractor as being correct and in strict conformance with the Contract Documents and shall include the following statement: “I have verified that the equipment or material in this submittal meets all the requirements specified or shown in the Contract Documents without exception.” In the case of Shop Drawings, each sheet shall be so dated, signed, and certified.

m. City of Thornton Project Manager will only accept submittals that have been so verified by Contractor. Non-verified submittals will be returned to Contractor without action taken by City of Thornton Project Manager, and any delays caused thereby shall be the total responsibility of Contractor. No changes in the Contract Times will be made for schedule delays resulting from non-compliant submittals.

n. Corrections or comments made on Contractor's Shop Drawings during review do not relieve Contractor from compliance with Contract Drawings and Specifications. Contractor is responsible for confirming and correlating quantities and dimensions, fabrication processes and techniques, coordinating Work with the trades, and satisfactory and safe performance of the Work.

1.6 SAMPLES

A. Submit the number of samples indicated by the Specifications. If the number is not indicated, submit not less than 3 samples. Where the amount of each sample is not indicated, submit such amount as necessary for proper examination and testing by the methods indicated.

B. Individually and indelibly label or tag each sample, indicating the salient physical characteristics and manufacturer's name. Upon acceptance by Designer, one set of the samples will be stamped and dated by City of Thornton Project Manager and returned to Contractor, one set of samples will be retained by City of Thornton Project Manager, and one set shall remain at the Site in Contractor's field office until completion of Work.

1.7 SURVEY DATA

A. Make available for examination throughout the construction period field books, notes, and other data developed by Contractor in performing the surveys required by the Work and submit such data to City of Thornton Project Manager with documentation required for final acceptance of Work.

1.8 QUALITY ASSURANCE/QUALITY CONTROL PLAN

A. Prepare and submit a Quality Assurance/Quality Control Plan for the Work within 20 Days after Notice to Proceed. This plan shall comply with Section 01 45 00, Quality Control.

1.9 RECORD DRAWINGS

A. Maintain one set of Drawings at the Site for the preparation of record drawings. On these, mark in red pencil every project condition, location, configuration, and any other change or deviation from the executed, conformed Contract Drawings at the time of award, including buried or concealed construction and utility features that are revealed during the course of construction. Special attention shall be given to recording the horizontal and vertical location of buried utilities that differ from the locations indicated or that were not indicated on the Contract Drawings. Said record drawings shall be supplemented by any detailed sketches as necessary or as Contractor is directed, to fully indicate the Work as actually constructed. These record drawings are the Contractor's representation of as-built conditions, shall include revisions made by addenda and change orders, and shall be maintained up-to-date during the progress of the Work. Red pencil shall be used for alterations and notes. Notes shall identify relevant Change Orders by number and date.

B. This may be accomplished either by the above method or by an electronic overlay method. If the electronic method is used the time constraints still apply but the submittal can be electronic.

C. On the 20th Day of every third month after the month in which the Notice to Proceed is given the City of Thornton Project Manager and Designer will review the field marked up drawing sets and determine if a revision needs to be issued. If one is required, submit paper or electronic markups to the designer for update and reissue. At the completion of the work, submit one final set of markups (paper or electronic) for creation of an as-built set of drawings.

D. Disorganized or incomplete record drawings will not be accepted. Contractor shall revise them and resubmit within 10 Days.

E. Make record drawings accessible to City of Thornton Project Manager and Designer during the construction period. Record drawings will be audited regularly by City of Thornton Project Manager and Designer after the month in which the Notice to Proceed is given as well as on completion of Work. Failure to properly maintain record drawings in an up-to-date condition may result in the withholding of payments due to Contractor at the sole discretion of OWNER.

F. Final payment will not be acted upon until the record drawings have been completed and delivered to City of Thornton Project Manager. Said record drawings shall be in the form of a set of prints with carefully plotted information overlaid and an electronic form under the latest release of Adobe Acrobat.

G. Information submitted by Contractor will be assumed to be correct, and Contractor shall be responsible for the accuracy of such information.

1.10 QUALITY CONTROL (QC) SUBMITTALS

A. Quality control submittals are defined by Section 01 45 00, Quality Assurance/Quality Control and the technical Specifications.

B. Unless otherwise indicated, QC submittals shall be submitted:

1. Before delivery and unloading, for the following types of submittals:
   a. Manufacturers' installation instructions
   b. Manufacturers' and Installers' experience qualifications
   c. Ready mix concrete delivery tickets
   d. Design calculations
   e. Affidavits and manufacturers' certification of compliance with indicated product requirements
   f. Laboratory analysis results
   g. Factory test reports

2. Within 30 days following the event documented for the following types of submittals:
   a. Manufacturers' field representative certification of proper installation
   b. Field measurement
   c. Field test reports
   d. Receipt of permit
   e. Receipt of regulatory approval

C. City of Thornton Project Manager will record the date that a QC submittal was received and review it for compliance with submittal requirements, but the review procedures above for Shop Drawings and samples will not apply.

1.11 DAILY FORCE REPORT

A. Submit to City of Thornton Project Manager a daily force report. Deliver report not later than 9:00 AM of the working day following the report date and include the following:

1. Day of week, date, Contractor name, and report number.
2. Summary of Work in process (segregated by Contractor and Subcontractor).
3. Details of Work accomplished including quantities of Work installed.
4. Summary of equipment working and where working.
5. Summary of manpower by Work element and Subcontractor.
6. Receipt of major equipment or materials.
7. All required testing performed and if available, documented results.
8. The cost, source, and amount of each class of materials used in completion of each subdivision of Work.
9. The cost, source, and amount of equipment received and used in each subdivision of Work.

10. Full and correct information as to the number of persons employed in connection with each subdivision of Work.

11. The classification, pay rate, and address of each person involved in Work.

1.12 OPERATION AND MAINTENANCE (O&M) MANUAL

A. Submit technical operation and maintenance information for each item of mechanical, electrical, and instrumentation equipment in an organized manner in the O&M Manual. It shall be written so that it can be used and understood by the OWNER's operation and maintenance staff. All O&M Manual materials shall be submitted in electronic and hard copy format. Submittal shall be in Adobe Acrobat format and any drawings shall not exceed 11 inch by 17 inch in size and text pages shall be only 8 ½ by 11 inches in size.

B. The O&M Manual shall be subdivided first by specification section number; second, by equipment item; and last, by "Category." The following "Categories" shall be addressed (as applicable):

1. Category 1 - Equipment Summary
    a. Summary: A table shall indicate the equipment name, equipment number, and process area in which the equipment is installed.
    b. Form: City of Thornton Project Manager will supply an Equipment Summary Form for each item of mechanical, electrical, and instrumentation equipment in the Work. Fill in the relevant information on the form and include it in Part 1.
2. Category 2 - Operational Procedures
    a. Procedures: Manufacturer-recommended procedures on the following shall be included in Part 2:
        - Installation
        - Adjustment
        - Startup
        - Location of controls, special tools, equipment required, or related instrumentation needed for operation
        - Operation procedures
        - Load changes
        - Calibration
        - Shutdown
        - Troubleshooting
        - Disassembly
        - Reassembly
        - Realignment
        - Testing to determine performance efficiency
        - Tabulation of proper settings for pressure relief valves, low and high pressure switches, and other protection devices
        - List of all electrical relay settings including alarm and contact settings
3. Category 3 - Preventive Maintenance Procedures
    a. Procedures: Preventive maintenance procedures shall include manufacturer-recommended procedures to be performed on a periodic

basis, both by removing and replacing the equipment or component, and by maintaining the equipment in place.

b. Schedules: Recommended frequency of preventive maintenance procedures shall be included. Lubrication schedules, including lubricant SAE grade, type, and temperature ranges, shall be covered.

4. Category 4 - Parts List
   a. Parts List: A complete parts list shall be furnished, including a generic description and manufacturer's identification number for each part. Addresses and telephone numbers of the nearest supplier and parts warehouse shall be included.
   b. Drawings: Cross-sectional or exploded view drawings shall accompany the parts list. Part numbers shall appear on the drawings with arrows to the corresponding part.

5. Category 5 - Wiring Diagrams
   a. Diagrams: Category 5 shall include complete internal and connection wiring diagrams for electrical equipment items.

6. Category 6 - Shop Drawings
   a. Drawings: This category includes approved shop or fabrication drawings with Designer comments and corrections incorporated, complete with dimensions.

7. Category 7 – Safety
   a. Procedures: This category describes the safety precautions to be taken when operating and maintaining the equipment or working near it.

8. Category 8 - Documentation:
   a. Equipment warranties, affidavits, certifications, calibrations, laboratory test results, etc. required by the technical Specifications shall be placed in this category.

C. Format

1. Each hard copy O&M Manual shall be bound in standard size 3 ring hardcover binders labeled on the spine and cover with project name, OWNER's project number, specification section number, equipment name, and equipment identification number.

2. Each binder shall contain its own detailed table of contents at the front, plus a summary level table of contents information for the other binders in a multi-binder set.

3. Documents in binders shall be 3 hole punched, no text shall be punched out, and pages larger than 8-1/2 inches by 11-inches shall be folded to 8-1/2 inches by 11-inches.

4. Each final set of O&M Manuals shall include a CD with electronic files:
   a. Project specific files created in Adobe Acrobat portable document format.
   b. Manufacturer literature in Adobe Acrobat portable document format.

D. Review Process

1. Contractor shall furnish 2 hard copies and one electronic copy of the draft O&M Manuals for each Specification Section that requires a Manual. City of Thornton Project Manager will forward one hard copy each to OWNER and Designer, and will refer other reviewers to the electronic version. City of Thornton Project Manager will return both copies to Contractor with review comments.
2. Contractor shall incorporate comments into the draft and submit one hard copy and 5 electronic copies on CD of the final Manual for acceptance.

E. Schedule

1. Except where indicated otherwise, manuals shall be submitted in final form to the City of Thornton Project Manager not later than the 75 percent of construction completion date. Discrepancies found by the City of Thornton Project Manager shall be corrected within 30 Days from the date of written notification by the City of Thornton Project Manager.
2. Work under this Contract involves commissioning of equipment in multiple areas. Manuals shall be complete for each piece of equipment prior to placing equipment into service. Final acceptance of the equipment by the OWNER will be dependent on operational training of the OWNER's personnel. Except where indicated otherwise, manuals shall be submitted for review in final form a minimum of 30 days prior to pre-commissioning and commissioning the start of performance testing for each piece of equipment. Discrepancies found by the City of Thornton Project Manager shall be corrected within 30 days from the date of written notification by the City of Thornton Project Manager.

1.13 SPARE PARTS LIST

A. Furnish to City of Thornton Project Manager 5 identical sets of spare parts information for mechanical, electrical, and instrumentation equipment. The spare parts list shall include those spare parts that each manufacturer recommends be maintained by the OWNER in inventory.

1. Sources and Pricing: The spare parts list shall include a current list price of each spare part. Each manufacturer or supplier shall indicate the name, address, and telephone number of its nearest outlet of spare parts to assist the OWNER in ordering.

B. Format: The spare parts lists shall be bound in standard size, 3 ring, loose-leaf, vinyl plastic hard cover binders suitable for bookshelf storage. Binder ring size shall not exceed 2-1/2 inches. Each copy of the spare parts lists shall be accompanied by a CD containing the lists in files created under Adobe Acrobat.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 33 50 - SITE CONDITIONS SURVEYS AND CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. Conduct preconstruction and post construction documentation surveys of the entire Site, complete, in accordance with the Contract Documents. Site condition surveys shall consist of field surveying, still photography, videotaping, and buried utility surveys.

B. Conduct preconstruction and post construction topographic surveys of the areas of the Work within and adjacent to the FEMA 100-year flood plain. Preconstruction post construction topographic surveys shall be adequate to ascertain pre-construction and post-construction conditions (including elevations) of property within the FEMA 100-year flood plain and shall extend up to 50-feet beyond the limits of the indicated flood plain (within the indicated easements). Sufficient photographs supplemented by digital video shall be a basis for resolving any damage claims, which may arise due to the construction of this Project.

C. Conduct engineering survey of buried utilities.

D. Documentation Survey Coverage

1. Photographs and videotaping shall be taken prior to any construction activities.
2. Continuous color audio digital video shall be recorded along the entire route of the proposed pipeline and associated working areas.
3. Video and photographic coverage shall include, but not be limited to, Contractor's working, storage, and operational areas on the Site, including lay down, interconnection, and disposal areas, existing roadways, sidewalks, curbs, driveways, buildings and structures, aboveground utilities, landscaping, trees, signage, access ways, and other physical features located within the zone of influence of construction. Minimum zone of influence shall extend to the construction easement or right-of-way limits and to nearby structures if in close proximity to the construction zone. Coverage may be expanded as directed by City of Thornton Project Manager.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Contractor Submittals.

B. Action Submittals:

1. Qualifications of video survey subcontractor.
2. Documentation survey plan including route: survey schedule and the method of documentation.
3. DVDs and logs of first day's site conditions surveys.
4. A copy of video surveys, photographs, and narrative logs of the pre-construction

conditions at least 7 calendar days prior to the commencement of any construction activities within the area of the survey.

C. Informational Submittals:

1. A copy of DVD video surveys, photographs, and narrative logs of the pre-construction conditions at least 7 calendar days prior to the commencement of any construction activities within the area of the survey.
2. Construction progress photographs, submit weekly.
3. Post-construction topographic mapping within 60 days of completing Work on any individual location indicated herein. Submit five copies of hardcopy plots and three sets of electronic files on compact discs in Microstation v8.1 or later.
4. Set of compact discs of all photographs, mapping, and survey data on the post construction conditions prior to final inspection.
5. Post-construction condition survey documentation within 14 calendar days of completing the Work in any area.

1.3 NOTIFICATION

A. Notify City of Thornton Project Manager, Owner, and property and utility owners, as appropriate, a minimum of 7 calendar days prior to the anticipated commencement of site conditions surveys in any one area and 24 hours in advance of actual start.

1.4 QUALIFICATIONS

A. Pre and post-construction DVD video surveys shall be conducted by a professional commercial videographer, experienced in shooting construction videos.

B. Minimum of 3 years of experience in video pre-construction surveys.

1.5 QUALITY ASSURANCE

A. Submit DVDs and logs for quality review and comment to City of Thornton Project Manager within 48 hours after the first days' Work is completed. Picture quality and definition shall be to the satisfaction of the City of Thornton Project Manager. Video or photographic equipment that fails to produce satisfactory image quality shall be removed.

PART 2 -- PRODUCTS

2.1 AUDIO-VIDEO DOCUMENTATION

A. Color on DVD, with sound.

B. Video:

1. Video should be submitted in one of the following formats;
   a. .avi
   b. .mp3
   c. .mov

2. Produce bright, sharp, and clear images with accurate colors, free of distortion and other forms of picture imperfections.

3. Electronically and accurately display the month, day, year, and time of day of the recording.

C. Audio:

1. Audio shall be clear, precise, and at a moderate pace.

2. Indicate date, project name, and a brief description of the location of taping, including:

a. Facility name.
b. Street names or easements.
c. Addresses of private property.
d. Direction of coverage, including engineering stationing, if applicable.
e. Narration of facilities and conditions observed.

D. Label each DVD with the following:

1. DVD number (numbered sequentially, beginning with 001).

2. Name of owner.

3. Title of Project including Schedule of Work.

4. Dates and times of video coverage.

5. Name of streets or easement(s) included.

6. Applicable location by engineering stationing.

7. Brief description of contents.

2.2 NARRATIVE LOG

A. Maintain an ongoing written narrative log of each video tape including:

1. Name of owner.

2. Title of Project including Schedule of Work.

3. Inclusive dates of video.

4. General location(s) of video.

5. Detail description of contents including location, date, and special features and observations.

2.3 PHOTOGRAPHIC DOCUMENTATION

A. Digital Format: Minimum resolution of 756 by 504 pixels and 24 bit, millions of colors, .jpeg format.

2.4 TOPOGRAPHIC SURVEYS

A. All pre and post-construction topographic mapping and other data, including spot

elevations, shall be prepared, signed and sealed by a Professional Land Surveyor registered in Colorado.

B. Electronic topographic files shall be three-dimensional.

C. Site mapping to document site conditions shall be submitted as a separate electronic map (drawing) in Microstation V8.1 or later.

2.5 ENGINEERING SURVEYS AND TOPOGRAPHIC MAPPING

A. Following location of buried utilities and improvements by excavation methods, conduct pre-construction survey of existing buried utilities and improvements or any portion thereof that will be encountered during execution of the Work.

1. Record horizontal coordinates (X,Y), elevation (Z), diameter or size of utility and materials of construction at a minimum of 2 locations bisecting new buried piping or improvements in the vicinity of existing utilities or improvements.
2. Accuracy of survey shall be not less than 0.01-foot.
3. Format of survey data and mapping files shall be as indicated below for post-construction surveys and mapping.
4. Protect existing facilities in accordance with Section 01 50 10 - Protection of Existing Facilities.

B. Topographic mapping shall be developed using the Project coordinates and shall be referenced to the Project base lines and benchmarks.

1. The electronic mapping files shall be produced using field survey techniques with sufficient accuracy for reproduction and use as base maps at a scale of one-inch = 40-feet horizontal and 1-foot contour intervals as required for National Map Accuracy Standards.
2. Electronic mapping files shall be 3 dimensional.
3. Submit point lists for topographic surveys in ASCII text file format.
4. Files shall be copied to one or more compact discs in a format acceptable to City of Thornton Project Manager.
5. Submit one digital copy survey data and drawings in pdf format and one copy of same in Microstation V8.1 or later compact disc or DVD and submitted using the City's Electronic Document Management System, eaDoc.

PART 3 -- EXECUTION

3.1 PRE- & POST-CONSTRUCTION SITE CONDITION DOCUMENTATION SURVEY

A. Conduct thorough pre- and post-construction site condition visual documentation surveys of the entire Project. Site conditions observations shall be documented by written logs and video recordings, supplemented by photographs. Pre- and post-construction site condition observations and documentation intended to be used to help resolve damage claims. Such documentation shall be used as indisputable evidence in ascertaining whether and to what extent damage occurred as a result of

Contractor's operations, and is for the protection of the adjacent property owners, Contractor, and Owner.

B. After the Effective Date of the Agreement and before Work at site is started on a particular area of Work and again within 10 days following date of Substantial Completion, Contractor, City of Thornton Project Manager, and affected property owners and utility owners shall make a thorough examination of pre-existing and post-construction conditions including existing buildings, structures, and other improvements in vicinity of Work.

C. In the case of pre-construction recording, no Work shall begin in the area prior to City of Thornton Project Manager's review and approval of content and quality of video for that area.

D. Periodic re-examination and post-construction site condition documentation survey shall be jointly performed to include, but not limited to, cracks in structures, settlement, leakage, and similar conditions.

E. Particular emphasis shall be directed to physical condition of the following:

1. Existing vegetation, fencing, buildings, and other structures, and pavement within the pipeline alignment and adjacent areas.
2. Creek crossings.
3. Access roads used to transport material or equipment to and from the Project site.
4. Any facilities or roads utilized by Contractor that are outside of the designated Work area.
5. All Work areas, including, but not limited to, actual Work sites, materials processing and stockpiling areas, access corridors, disposal areas, and staging areas.
6. Existing structures within 40 feet of an excavation and 150 feet of dewatering.
7. Landscaping and property owner features and improvements.
8. Work adjacent to or involving connection to existing facilities.
9. Any work completed by other contractors at the site that will be impacted or otherwise affected by the Contractor's Work.
10. Other as selected by the City of Thornton Project Manager.

F. Submit audio, video, and photographic documentation survey of pre-construction site condition documentation at least 7 calendar days prior to the start of construction in any area.

G. Complete post-construction documentation surveys of within 7 calendar days after completing in any areas.

H. Submit post-construction survey documentation within 14 calendar days after completing the Work in any area.

3.2 DOCUMENTATION

A. Video record the site conditions along the full length of access roads and pipeline routes.

B. Provide narrative description of any special site features, observations and conditions.

C. Summarize contents of each video with a narrative written log.

D. Supplement video surveys with photographs as required to document specific features and observations.

3.3 TOPOGRAPHIC SURVEYS

A. Topographic mapping shall be developed for fill and embankment areas using the Project coordinates, shall be referenced to the Project base lines and benchmarks, and shall be adequate to ascertain post-construction conditions (including elevations) of all areas within and extending to 50-feet beyond the FEMA 100 year flood plain in all directions. All work shall be conducted in designated work areas.

B. Field survey techniques with sufficient accuracy for reproduction and use as base maps at a scale of 1 inch to 40 feet horizontal and 1-foot contour intervals as specified for National Map Accuracy Standards. All topographic surveys used to demonstrate additional excavation shall be produced using field survey techniques with sufficient accuracy to provide a contour interval equal to the contour interval of the topography shown or a 1-foot contour interval, whichever provides the greater level of accuracy.

C. All files shall be copied to one or more compact discs (or DVD) in a format acceptable to Designer and City of Thornton Project Manager.

3.4 CONSTRUCTION PROGRESS PHOTOGRAPHS

A. Photographically demonstrate progress of construction showing every aspect of site and adjacent properties as well as interior and exterior of new or impacted structures, and utility crossings and relocations. Provide a minimum of 20 photographs each week for each schedule showing the progress of the Work.

B. Set date and time of record on the image.

C. Number each photo image and identify location of photo.

D. Maintain a photo log.

E. Upload and catalog all construction photographs using Owner-provided web-based the Electronic Document Management System. Label date, time, location, subject, station and direction of photographs.

3.5 FINAL REPORT

A. Upon completion of post-construction site condition survey, transfer all DVDs, digital photographs, and narrative logs of the pre-construction, construction progress and post-construction site conditions surveys to external hard drive of sufficient capacity and compatibility with Owner's equipment.

- END OF SECTION -

SECTION 01 33 51 - PROJECT RECORD DOCUMENTS

PART 1 -- GENERAL

1.1 SCOPE

A. The Contractor shall keep and maintain, at the job site, a copy of contract documents, marked up to indicate all changes made during the course of a project, as specified herein.

1.2 RELATED REQUIREMENTS

A. Contract Close-out submittals are included in Section 01 77 00.

B. Record shop drawings are included in Section 01 33 00.

1.3 REQUIREMENTS INCLUDED

A. Contractor shall maintain a record copy of the following documents, marked up to indicate all changes made during the course of a project:

1. Contract Drawings
2. Specifications

B. Contractor shall assemble copies of the following documents for turnover to the Engineer at the end of the project, as specified.

1. Field Orders, Change Orders, Work Change Directives, and RFIs
2. Field Test records
3. Permits and permit close-outs (final approvals)
4. Certificate of Occupancy or Certificate of Completion, as applicable
5. Certificates of Compliance for materials and equipment
6. Record Shop Drawings
7. Samples

C. RECORD DRAWINGS

1. The Contractor shall annotate (mark-up) the Contract Drawings to indicate all project conditions, locations, configurations, and any other changes or deviations that vary from the original Contract Drawings. This requirement includes, but is not limited to, buried or concealed construction, and utility features that are revealed during the course of construction. Special attention shall be given to recording the locations (horizontal and vertical) and material of all buried utilities that are encountered during construction – whether or not they were indicated on the Contract Drawings. The record information added to the drawings may be supplemented by detailed sketches, if necessary, clearly indicating, the WORK, as constructed.
2. These annotated Contract Drawings constitute The Contractor's Record

Drawings and are actual representations of as-built conditions, including all revisions made necessary by change orders, design modifications, requests for information and field orders.

3. Record drawings shall be accessible to the Owner and Engineer at all times during the construction period.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 MAINTENANCE OF RECORD DOCUMENTS AND SAMPLES

A. Store documents and samples in Contractor's field office apart from documents used for construction.

1. Provide files and racks for storage of the record documents.
2. Provide locked cabinet(s) or secure storage space for storage of samples.

B. File documents and samples in accordance with Construction Specifications Institute (CSI) format.

C. Maintain documents in a clean, dry, legible, condition and in good order. Do not use record documents for construction purposes.

D. Make documents and sample available for inspection by the Engineer or Owner at all times.

E. Up-to-date Record Drawings may be a pre-requisite of processing periodic monthly pay applications, if so specified under the section for progress payments.

3.2 MARKING METHOD

A. Use the color *Red* (indelible ink) to record information on the Drawings and Specifications,

B. Label each document "PROJECT RECORD" in neat large printed letters.

C. Unless otherwise specified elsewhere, notations shall be affixed to hardcopies of documents.

D. Record information contemporaneously with construction progress.

E. Legibly mark drawings with as-built information:

1. Elevations and dimensions of structures and structural elements.
2. All underground utilities (piping and electrical), structures, and appurtenances
3. Changes to existing structure, piping and appurtenance locations.
4. Record horizontal and vertical locations of underground structures, piping, utilities and appurtenances, referenced to permanent surface improvements.

5. Record actual installed pipe material, class, size, joint type, etc.

3.3 RECORD INFORMATION COMPILATION

A. Do not conceal any work until the required information is acquired.

B. Items to be recorded include, but are not limited to:

1. Location of internal utilities and appurtenances concealed in the construction – referenced to visible and accessible features.
2. Field changes of dimensions and/or details
3. Interior equipment and piping relocations.
4. Architectural and structural changes, including relocation of doors, windows, etc.
5. Architectural schedule changes.

C. Changes made by Field Order, Change Order, design modification, and RFI.

D. Details not indicated on the original Contract Drawings.

E. Specifications - legibly mark each Section to record:

1. Manufacturer, trade name, catalog number, and Supplier of each product and item of equipment actually installed.
2. Changes made by Field Order, Change Order, RFI, and approved shop drawing.

3.4 SUBMITTAL

A. If specified under the section for progress payments, monthly applications for payment will be contingent upon up-to-date Record Drawings. If requested by the Engineer or Owner, Contractor shall provide a copy of the Record Drawings, or present them for review prior to processing monthly applications for payment.

B. Upon substantial completion of the WORK and prior to final acceptance, the Contractor shall finalize and deliver a complete set of Record Drawings to the ENGINEER conforming to the construction records of the Contractor. The set of drawings shall consist of corrected and annotated drawings showing the recorded location(s) of the WORK. Unless specified otherwise elsewhere, Record Drawings shall be in the form of a set of prints with annotations carefully and neatly superimposed on the drawings in red.

C. Upon substantial completion of the WORK and prior to final acceptance, the Contractor shall finalize and deliver a complete set of Record Documents to the ENGINEER conforming to the construction records of the Contractor. The set of documents shall consist of corrected and annotated documents showing the as-installed equipment and all other as-built conditions not indicated on the Record Drawings.

D. The information submitted by the Contractor into the Record Drawings and Record Documents will be assumed to be correct, and the Contractor shall be responsible

for the accuracy of such information, and shall bear the costs resulting from the correction of incorrect data.

E. Delivery of Record Drawings and Record Documents to the ENGINEER will be a prerequisite to Final payment.

F. The Contractor shall maintain a copy of all books, records, and documents pertinent to the performance under this Agreement for a period of 5 years following completion of the contract.

- END OF SECTION -

SECTION 01 35 29 - HEALTH AND SAFETY

PART 1 -- GENERAL

1.1 SAFETY PROGRAM

A. Contractor's safety program shall conform to the requirements of the Contract Documents. Within 20 Days after the Notice to Proceed, demonstrate compliance action with the stipulations of the Occupational Safety and Health Administration (OSHA), Mine Safety and Health Administration (MSHA), and other applicable local, state, and federal safety requirements by submitting to City of Thornton Project Manager a copy of all safety plans, programs, and permits. Such plans and programs shall include, but are not limited to:

- Safe Work Plan (Job Safety Analysis, JSA)
- Emergency Plan
- Rigging and Hoisting Plans
- Excavation and Trenching Plans
- Respiratory Protection Program
- Fire Protection Plan
- Safety Plan and Hazard Protection Program
- Hazard Analysis Prior to Major Activities
- Confined Space Entry Program
- Electrical Safety
- Lock Out/Tag Out
- Fall Protection
- Heavy Equipment Operations
- Burning and Welding Operations
- Training Plan
- Project Rules and Regulations
- Material Handling (storage-disposal)
- Fuel Storage and Refueling
- Hazard Communication Program
- Personal Protective Equipment (hearing, eye, face)
- Traffic Control
- Environmental Controls
- Security
- Drug Testing
- Safety Meetings
- Spill Control Plan
- First Aid Facilities

B. For the purposes of this Section, an "active construction area" is any area where construction activities are occurring or construction activities could be considered a potential hazard to people.

C. Contractor's obligations for safety shall be implemented in such manner that they are understood and carried out by all, including non-English speaking employees.

D. City of Thornton Project Manager's receipt of any safety plans or programs will not relieve Contractor in any way from the full and complete responsibility for safety and

training of Contractor's personnel, and the onsite personnel of Owner, City of Thornton Project Manager, Designer, and other visitors to areas of construction activity. On a daily basis, Contractor shall inform City of Thornton Project Manager of changes to the boundaries of the active construction areas.

E. Emergency Owner operations and maintenance will take precedence over Contractor's schedule. Emergencies in excess of 8 hours and which disrupt Contractor's scheduled activities will be considered by Owner as a differing Site condition.

F. Contractor shall be responsible for safety training all Contractor, Supplier, Subcontractor, and other personnel who will have access to the active construction areas.

G. Safety Program Requirements:

1. IMMEDIATE notification to City of Thornton Project Manager of an accident is REQUIRED.

2. Contractor's Safety Personnel Requirements:

   a. Contractor shall assign a Contractor Safety Manager as defined by the General Conditions. This position is not required to be full-time. Contractor shall determine time required for the safety representative to fulfill the requirements of the Contract.

   b. The Safety Representative's duties and responsibilities will be hazard recognition, accident prevention, new employee orientation (including Subcontractor's employees), and the maintaining and supervising of safety precautions and program. This person shall have no other duties. The Safety Representative or a qualified and approved deputy shall be onsite at all times while Work is ongoing.

   c. Submit Qualifications of the Safety Representative and assigned deputies to City of Thornton Project Manager for review. Acceptance of their qualifications by City of Thornton Project Manager is required prior to the start of any activity on the Project. The Contractor's Safety Representative shall meet the requirements of regulations for the Colorado Occupational Safety & Health Enforcement Program, as defined in the following paragraph:

      A Designated Safety Officer (Safety Representative for the purposes of this Contract) means anyone who is capable of identifying the existing and predictable hazards in the areas surrounding a construction project or those working conditions at a construction project that are unsanitary or dangerous to employees. A Designated Safety Officer has the authority to make prompt corrective measures to eliminate those hazards.

3. Hazardous Substances and the Right to Know:

   a. Provide Safety Representative with a list of all hazardous substances Contractor anticipates to bring onsite.

   b. Submit a Material Safety Data Sheet (MSDS) to the Safety Representative prior to arrival of any hazardous substances on the Project.

   c. Storage areas shall be as approved by the Safety Representative.

d. Use storage areas according to Contractor's Spill Control Plan.

e. Remove all used and unused hazardous chemicals from the Site at Completion of Work.

f. Prepare a hazard-specific safety training (HAZCOM) lesson plan for each hazardous substance brought to the Site. Conduct and document training based on these lesson plans. Provide copies of HAZCOM training documentation to the City of Thornton Project Manager.

4. Job Safety Analysis (JSA):

a. Outline the sequence of Work, equipment to be used, identify hazards that may exist or may be created and what procedures and/or safety equipment will be used to eliminate or reduce these hazards. Prepare and submit a Scope of Work JSA to the Safety Representative prior to the start of activities on the Project. The name of the competent person assigned to this activity shall be included on the JSA.

b. Complete a JSA for any activity that may be of an unusual nature or involves unique hazards.

5. Reports

a. Furnish to City of Thornton Project Manager copies of Contractor's and Subcontractor's:

1. First aid log (monthly).
2. OSHA 200 injury log (monthly).
3. Certification of new employee orientation (monthly).
4. Safety meeting reports and topics.
5. List of competent persons as required by OSHA.
6. Injury and accident reports, submitted within 24 hours of any incident.
7. Records of employee and supervisor training, including Subcontractors.

b. Conduct weekly safety inspections, and take corrective actions within 24 hours to address all deficiencies identified during inspections. Prepare and submit deficiency reports to City of Thornton Project Manager within 48 hours indicating corrective actions taken. Contractor's failure to comply with required corrective measures identified in the safety inspection will result in the delayed signing of the monthly application for progress payment by City of Thornton Project Manager.

H. Submit to City of Thornton Project Manager a report of each periodic audit conducted by Contractor of its safety records and performance.

I. At a minimum, follow the applicable regulations in 29CFR1910. Examples of such applicable regulations include but are not limited to:

1. 29CFR1910.146: Confined Space Entry Program
2. 29CFR1910 Subpart Q: Burning and Welding Operations

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 EMERGENCY SERVICES NOTIFICATION

1. Sites within City of Thornton

   A. When calling to request a standby or giving information regarding a street closure in City of Thornton for Thornton Fire or Police, the following information is required to be obtained by City of Thornton Public Safety Communications personnel. When calling please ask for a Lead or Supervisor, as they will be your point of contact.

   B. All notifications should be made 24 hours in advance.

      Dispatch non-emergent line – 720-977-5150

      Initially, please let the Lead or Supervisor know what company you are with, and that you are calling to inform them of a street closure or need for fire and or police standby. Then you will be asked to provide the following information.

      1. Contact information:
         a. Company and name
         b. Call back phone number (give best number to reach you in case of emergency, i.e., cell phone if you are going to be in the field and not desk phone.)
         c. Who is the point of contact
         d. Street that is closed? (From what street to what street.)
         e. Duration of the street closure? (What time the project starts until the expected time to reopen.)
         f. Is street accessible for Fire and Police response?
         g. Do you need a standby (on scene) or is this just for information in the event an emergency arises?
         h. Personnel working above or below ground?
         i. Kind of safety measures in place?
         j. Any other pertinent information.

      2. You (the caller) will be asked to call back and advise Public Safety Communications when the street(s) or back in service or the standby is no longer needed.

2. Sites outside City of Thornton

   A. Use local jurisdiction Fire, Police or 911 for emergency services as deemed appropriate.

- END OF SECTION -

SECTION 01 35 53 - SITE SECURITY

PART 1 -- GENERAL

1.1 SECURITY PROGRAM

A. Protect Work, the Site, stored materials and equipment, existing premises, vehicles and equipment from theft, vandalism, and unauthorized entry.

B. Initiate security program at mobilization.

C. Maintain site security program throughout construction period.

D. Maintain erosion fencing, barrier fencing, livestock fencing and property owner fencing as directed by the City of Thornton Project Manager.

E. Maintain safe and secure site in accordance with Section 01 35 29 – Health and Safety and the Contractor's Safety Program.

F. Submit security plan in accordance with Section 01 33 00 – Contractor Submittals.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 41 26 - PERMITS AND AGREEMENTS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall obtain required permits for the execution of the Work in accordance with the Contract Documents. Furnish copies of all permits obtained by Contractor to the City of Thornton Project Manager. Materials submitted to the City of Thornton Project Manager includes, but is not limited to, completed application materials, the permit, written correspondence between the Contractor and the regulatory agency issuing the permit and any information required to be submitted to demonstrate compliance with permit terms and conditions (i.e. inspection reports).

B. Comply with all conditions of the permits.

C. Any fees listed in this Section are estimates and for Contractor's information only. Contractor shall verify and pay actual fees.

D. Completeness of the permit list is not guaranteed by Owner. The absence of information does not relieve Contractor of responsibility for determining and verifying the extent of permits required and of obtaining all permits.

E. Certain permit applications have been obtained during design and are provided herein for Contractor's convenience. Owner does not guarantee the accuracy or completeness of the permit applications, requirements, and /or fees. Contractor shall be responsible for verification of all permit application forms, fees and requirements.

F. Contractor is responsible for confirming lead and review timeframes associated with permit submittal and approval.

G. The Contractor's attention is directed to Specification 01 50 10 Protection of Existing Facilities for information related to permits and constraints associated with utility crossings.

1.2 SUMMARY OF PERMITS TO BE OBTAINED BY CONTRACTOR

A. The following permits shall be obtained by Contractor. Contractor shall coordinate permit applications and submittals directly with the City of Thornton Project Manager and the Owner's permit coordinator. For those Contractor permits where standard permit application forms are available, such application forms have been included in

Supplement A located at the end of this volume for the Contractor's convenience. For permits for which standard permit forms are not available, Contractor shall complete permit application process in person at each jurisdiction's permit center for those required permits for which courtesy copies of applications are not provided in Supplement A.

B. Completed application materials, fully executed and agency approved permits, written correspondence between the Contractor and the regulatory agency issuing the permit and any information required to be submitted to demonstrate compliance with permit terms and conditions (i.e. inspection reports) shall be submitted to the City of Thornton Project Manager in accordance with Specification Section 01 33 00 – Contractor Submittals.

C. Contractor shall be responsible for incorporating all permit requirements, permit lead times, submittal review periods and re-submittals into the Contractor's CPM Schedule.

D. Local permits obtained shall be for use within applicable local jurisdictions as indicated and as regulated by agencies having jurisdiction. State-issued permits shall be for use within the entire Site unless the location is otherwise specifically indicated.

E. The following is a list of permits and a summary of Contractor actions that is not all inclusive of Contractor requirements associated with these applications:

F. Known probable Permits to be Obtained by Contractor

Permitting Authority	**Permit Name**	**Permittee**
CDPHE-AQCD	Air Pollution Emissions Notice (APEN)	Contractor
CDPHE-WQCD	Construction Dewatering Permit	Contractor
CDPHE-WQCD	Construction Stormwater Discharge Permit	Contractor
CDPHE-WQCD	Light Industrial and Domestic Wastewater Discharge Permit	Contractor
CDPHE-WQCD	Minimal Industrial Discharge Permit (MINDI) for Leak Testing	Contractor
City of Thornton	Right of Way Permit and Bond	Contractor
City of Thornton	Traffic Control Permit	Contractor
City of Northglenn	Right of Way Permit and Bond	Contractor
City of Northglenn Parks and Recreation	Storm Water Quality Permit	Contractor
City of Northglenn	Traffic Control Permit	Contractor
Adams County	Storm Water Quality Permit	Contractor

1.3 SUMMARY OF PERMITS AND AGREEMENTS OBTAINED BY OWNER

A. Owner has obtained or will obtain approval of the construction drawings from appropriate jurisdictions. Owner will provide approved construction drawings to Contractor prior to Notice to Proceed.

B. The following permits and agreements have been or will be obtained by Owner. Copies of the permits or their requirements, if applicable, will be given to the Contractor at the preconstruction meeting. Unless the location is otherwise specifically indicated, permits apply to the entire Site. Contractor shall satisfy the conditions of said permits.

C. Contractor shall be responsible for incorporating all permit requirements, permit lead times, submittal review periods and re-submittals into the Contractor's CPM Schedule.

D. No additional compensation or additional Contract Times will be granted to Contractor because of delays by Owner in obtaining any permit unless Contractor is unable to proceed and complete Work and such delays are clearly demonstrated by the Contractor's Progress schedule.

E. Should the Contractor need to construct borehole structures (e.g. monitoring and observation holes, test holes, and dewatering wells), the Contractor shall notify the Owner's permit coordinator so that the Owner can submit a Notice of Intent to the state Division of Water Resources. A Notice of Intent shall be filed with the state Division of Water Resources at least three days prior to construction of the structure. Contractor shall have confirmation from the permit coordinator that the Notice has been filed prior to initiating construction of the structure. The structure must be constructed within ninety days of the date of the Notice of Intent. Closure requirements will be borehole structure specific.

F. Contractor shall adhere to the following requirements per agreements obtained by the Owner. The following summary is not all inclusive of Contractor requirements associated with agreements:

1. Adams County Annual Maintenance Permit
2. The Contractor shall cover all hauling/construction trucks pursuant to C.R.S. 42-4-1407.
3. Maintenance of the haul route and/ or construction traffic route, including dust abatement shall be the responsibility of the Contractor. Contractor shall repair any rutting and potholes as required by the Department of Public Works.
4. All construction vehicles shall have a radar activated or white noise backup alarm

for their equipment to minimize noise impacts to the area.

5. If fuel will be stored on site:
   a. All fuel storage shall be provided with secondary containment, which complies with State of Colorado Oil Inspection Section Regulations
   b. Fueling areas shall be separated from the rest of the site's surface area, and protected from storm water; and
   c. Contractor shall provide a spill prevention plan and release prevention plan for fuel storage and fueling operations. Spill and drip containment pans shall be emptied frequently and all spills shall be cleaned and disposed immediately at a facility permitted for such disposal.

1.4 EASEMENTS – PROPERTY OWNERS

Refer to Section 01 14 00 – Construction Constraints for easement and property owner constraints and provisions.

1.5 STORMWATER MANAGEMENT AND EROSION CONTROL PLAN

The CDPHE-WQCD Construction Stormwater Discharge Permit, the City of Thornton Stormwater Quality Permit, and the City of Thornton Special Exception Permit, all require that the Contractor comply with the Stormwater Management and Erosion and Sediment Control Plan provided as a supplement at the end of this volume. The Contractor shall comply with the plan as part of the corresponding permit to be obtained by the Contractor from each jurisdiction. The Contractor will be required to present an approved CDPHE-WQCD Construction Stormwater Discharge Permit in order to obtain local grading permits from the other jurisdictions. Jurisdictions listed in this paragraph other than the CDPHE-WQCD have reviewed and commented on the Plan. Comments from jurisdictions have been incorporated into the Plan for final approval. Final approval of the Plan is contingent on the Contractor application for permit.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 42 13 - ABBREVIATIONS AND ACRONYMS

PART 1 -- GENERAL

1.1 ABBREVIATIONS AND ACRONYMS

A. Abbreviations for trade organizations and government agencies: Following is a list of construction industry organizations and government agencies to which references may be made in the Contract Documents, with abbreviations used.

1.	AA	Aluminum Association
2.	AABC	Associated Air Balance Council
3.	AASHTO	American Association of State Highway and Transportation Officials
4.	ABMA	American Bearing Manufacturers' Association
5.	ACGIH	American Conference of Governmental Industrial Hygienists
6.	ACI	American Concrete Institute
7.	AF&PA	American Forest and Paper Association
8.	AGA	American Gas Association
9.	AGMA	American Gear Manufacturers' Association
10.	AI	Asphalt Institute
11.	AIA	American Institute of Architects
12.	AIHA	American Industrial Hygiene Association
13.	AIIM	Association for Information and Image Management
14.	AISC	American Institute of Steel Construction
15.	AISI	American Iron and Steel Institute
16.	AMCA	Air Movement and Control Association
17.	ANSI	American National Standards Institute
18.	API	American Petroleum Institute
19.	APWA	American Public Works Association
20.	ASAE	American Society of Agricultural Engineers
21.	ASCE	American Society of Civil Engineers
22.	ASME	American Society of Mechanical Engineers
23.	ASNT	American Society for Nondestructive Testing
24.	ASQ	American Society for Quality
25.	ASTM	ASTM International
26.	ATSSA	American Traffic Safety Services Association
27.	AWCI	American Wire Cloth Institute
28.	AWS	American Welding Society
29.	AWWA	American Water Works Association
30.	BBC	Basic Building Code, Building Officials and Code Administrators International
31.	BHMA	Builders Hardware Manufacturers' Association
32.	CABO	Council of American Building Officials
33.	CBM	Certified Ballast Manufacturer
34.	CDA	Copper Development Association
35.	CDOT	Colorado Department of Transportation
36.	CEMA	Conveyors Equipment Manufacturer's Association
37.	CGA	Compressed Gas Association
38.	CISPI	Cast Iron Soil Pipe Institute
39.	CLFMI	Chain Link Fence Manufacturer's Institute

40.	CMAA	Crane Manufacturers' Association of America
41.	CRSI	Concrete Reinforcing Steel Institute
42.	CS	Commercial Standard
43.	CSA	Canadian Standards Association
44.	CSI	Construction Specifications Institute
45.	DCDMA	Diamond Core Drilling Manufacturer's Association
46.	DIN	Deutsches Institut für Normung e.V.
47.	DIPRA	Ductile Iron Pipe Research Association
48.	EI	Energy Institute
49.	EIA	Electronic Industries Alliance
50.	EJCDC	Engineers Joint Contract Documents' Committee
51.	FAA	Federal Aviation Administration
52.	FCC	Federal Communications Commission
53.	FCI	Fluid Controls Institute
54.	FDA	Food and Drug Administration
55.	FEMA	Federal Emergency Management Agency
56.	FHWA	Federal Highway Administration
57.	FIPS	Federal Information Processing Standards
58.	FEMA	Federal Emergency Management Agency
59.	FHWA	Federal Highway Administration
60.	FIPS	Federal Information Processing Standards
61.	Fed. Spec.	Federal Specifications (FAA Specifications)
62.	FS	Federal Specifications and Standards (Technical Specifications)
63.	GESC	Grading, Erosion, and Sediment Control
64.	HI	Hydraulic Institute
65.	HMI	Hoist Manufacturers' Institute
66.	HSWA	Federal Hazardous and Solid Waste Amendments
67.	IAPMO	International Association of Plumbing and Mechanical Officials
68.	IBC	International Building Code
69.	ICBO	International Conference of Building
70.	ICC	International Code Council
71.	ICEA	Insulated Cable Engineers' Association
72.	IFC	International Fire Code
73.	IEEE	Institute of Electrical and Electronics Engineers, Inc.
74.	IFI	Industrial Fasteners Institute
75.	IMC	International Mechanical Code
76.	INDA	Association of the Nonwoven Fabrics Industry
77.	IPC	International Plumbing Code
78.	ISA	Instrumentation, Systems, and Automation Society
79.	ISO	International Organization for Standardization
80.	ITL	Independent Testing Laboratory
81.	JIC	Joint Industry Conferences of Hydraulic Manufacturers
82.	MIL	Military Specifications
83.	MUTCD	Manual of Uniform Traffic Control Devices
84.	NACE	National Environmental Balancing Bureau
85.	NEBB	National Environmental Balancing Bureau
86.	NEC	National Electrical Code
87.	NECA	National Electrical Contractors Association
88.	NEMA	National Electrical Manufacturers' Association
89.	NESC	National Electrical Safety Code

90.	NETA	InterNational Electrical Testing Association
91.	NFPA	National Fire Protection Association
92.	NICET	National Institute for Certification in Engineering Technologies
93.	NIST	National Institute of Standards and Technology
94.	NRCA	National Roofing Contractors Association
95.	NRTL	Nationally Recognized Testing Laboratories
96.	NSF	NSF International
97.	NSPE	National Society of Professional Engineers
98.	OSHA	Occupational Safety and Health Act (both Federal and State
99.	PCI	Precast/Prestressed Concrete Institute
100.	PEI	Porcelain Enamel Institute
101.	PPI	Plastic Pipe Institute
102.	PS	Product Standards Section-U.S. Department of Commerce
103.	RMA	Rubber Manufacturers' Association
104.	RUS	Rural Utilities Service
105.	SAE	Society of Automotive Engineers
106.	SMACNA	Sheet Metal and Air Conditioning Contractors National Association
107.	SPI	Society of the Plastics Industry
108.	SSPC	The Society for Protective Coatings
109.	TEMA	Tubular Exchanger Manufacturers' Association
110.	TIA	Telecommunications Industry Association
111.	UBC	Uniform Building Code
112.	UFC	Uniform Fire Code
113.	UL	Underwriters Laboratories Inc.
114.	UMC	Uniform Mechanical Code
115.	UNCC	Utility Notification Center of Colorado
116.	USBR	U.S. Bureau of Reclamation

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 42 19 - REFERENCE STANDARDS

PART 1 -- GENERAL

1.1 REFERENCE TO STANDARDS AND SPECIFICATIONS OF TECHNICAL SOCIETIES

A. Reference to standards and specifications of technical societies and reporting and resolving discrepancies associated therewith shall be as provided in Paragraph 3.02 of the General Conditions, and as may otherwise be required herein and in the individual Specification sections.

B. Work specified by reference to published standard or specification of government agency, technical association, trade association, professional society or institute, testing agency, or other organization shall meet requirements or surpass minimum standards of quality for materials and workmanship established by designated standard or specification.

C. Where so specified, products or workmanship shall also meet or exceed additional prescriptive or performance requirements included within Contract Documents to establish a higher or more stringent standard of quality than required by referenced standard.

D. Where two or more standards are specified to establish quality, product and workmanship shall meet or exceed requirements of most stringent.

E. Where both a standard and a brand name are specified for a product in Contract Documents, proprietary product named shall meet or exceed requirements of specified reference standard.

F. Copies of most applicable referenced standards have not been bound in these Contract Documents.

G. Where copies of standards are needed by Contractor, obtain a copy or copies directly from publication source and maintain in an orderly manner at the Site as Work Site records, available to Contractor’s personnel, Subcontractors, Owner, and City of Thornton Project Manager.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 45 00 - QUALITY ASSURANCE/QUALITY CONTROL

PART 1 -- GENERAL

1.1 SUBMITTALS

A. Qualifications of the Contractor's QA/QC Representative must include all qualifying registrations and show that the candidate has had experience on projects of similar type and size.

B. Contractor's Quality Assurance/Quality Control Plan: No payments will be made to Contractor until the Plan is accepted by City of Thornton Project Manager.

C. Contractor's Daily Quality Control Report: Submit to City of Thornton Project Manager within 2 days of completion of each inspection.

D. Daily Inspection Report: Submit to City of Thornton Project Manager at the end of each working day or no later than prior to the beginning of the next working day.

1.2 CONTRACTOR'S INSPECTION OF THE WORK

A. Work performed by Contractor shall be inspected by the Contractor's QA/QC Representative. Non-conforming Work and any safety hazards in the Work area shall be noted and promptly corrected.

B. No materials or equipment shall be used in Work without inspection and acceptance by Contractor's QA/QC Representative.

C. Materials and equipment furnished to Contractor by Owner shall be inspected by Contractor's QA/QC Representative upon receipt of such materials and equipment, with the results of the inspection included in the Contractor's Daily Inspection Report. In the event Contractor believes any material or equipment provided by Owner to be of insufficient quality for use in Work, Contractor shall immediately notify City of Thornton Project Manager.

1.3 OWNER'S INSPECTION AND TESTING

A. The Work will be conducted under the general observation of the City of Thornton Project Manager and is subject to inspection by representatives of Owner to ensure strict compliance with the requirements of the Contract Documents.

B. City of Thornton Project Manager will perform independent quality assurance audits to verify that actions specified in the Contractor's QA/QC Plan have been implemented. No City of Thornton Project Manager audit finding or report shall in any way relieve Contractor from any requirements of this Contract.

C. Testing services provided by Owner are for the sole benefit of Owner, however, one copy of the results of each field and laboratory test made will be made available to Contractor and any nonconforming results will be corrected by the contractor at no additional cost to the owner. All cost for retesting required shall be reimbursed to the owner.

D. Testing necessary to satisfy Contractor's internal quality control procedures shall be the sole responsibility of Contractor.

1.4 QUALIFICATIONS

A. Contractor's QA/QC Representative: Demonstrate having performed similar QA/QC functions on similar type projects. Submit records of personnel experience, training, and qualifications.

1.5 COVERING WORK

A. Whenever Contractor intends to backfill, bury, cast in concrete, hide, or otherwise cover any Work, notify City of Thornton Project Manager not less than 3 days in advance to request inspection before beginning any such Work of covering. Failure of Contractor to notify City of Thornton Project Manager in accordance with this requirement shall be resolved according to Article 13 of the General Conditions.

1.6 REJECTED WORK

A. Failure to promptly remove and replace rejected Work will be considered a breach of this Contract, and Owner may proceed under provisions of the General Conditions.

1.7 CONTRACTOR'S QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

A. General:

1. Establish and execute a Quality Assurance/Quality Control (QA/QC) program for Work. The program shall establish adequate measures for verification and conformance to defined requirements by Contractor personnel and lower-tier Subcontractors (including fabricators, suppliers, and sub-subcontractors). This program shall be described in a Plan responsive to this Section.

B. QA/QC Personnel:

1. The Contractor QA/QC Representative shall be on-site as often as necessary, but not less than the daily working hours specified in the Contract Documents to remedy and demonstrate that Work is being performed properly and to make multiple observations of Work in progress.

2. The Contractor is to furnish personnel with assigned QA/QC functions reporting to the QA/QC Representative. Persons performing QA/QC functions shall have sufficient qualifications, authority, and organizational freedom to identify quality problems and to initiate and recommend solutions.

C. QA/QC Plan:

1. Contractor's QA/QC Plan shall include a statement by the Senior Manager designating the QA/QC representative and specifying the authority delegated to the QA/QC Representative to direct cessation or removal and replacement of defective Work.

2. Describe the QA/QC program and include procedures, work instructions, and records. Describe methods relating to areas that require special testing and procedures as required by the specifications.

3. Include specific instructions defining procedures for observing Work in process and comparing this Work with the Contract requirements (organized by specification section).
4. Describe procedures to ensure that equipment or materials that have been accepted at the Site are properly stored, identified, installed and tested.
5. Include procedures to verify that procured products and services conform to the requirements of the Specifications. Requirements of these procedures shall be applied, as appropriate, to lower-tier Suppliers and/or Subcontractors.
6. Testing Quality Assurance: Include procedures to verify that the testing requirements of the Contract Documents are integrated into the Contractor's QA/QC Plan and conform to the requirements of the Specifications. Requirements of these procedures shall be applied, as appropriate, to the Contractor and lower-tier Suppliers and/or Subcontractors.
7. Include instructions for recording observations and requirements for demonstrating through the Daily Inspection Reports that Work observed was in compliance or a deficiency was noted and action to be taken.
8. Procedures to preclude the covering of deficient or rejected Work.
9. Procedures for halting or rejecting Work.
10. Procedures for resolution of differences between the QA/QC Representative and the production personnel.
11. Identify contractual hold/inspection points as well as any Contractor-imposed hold/inspections points.

D. Daily Inspection Report: Include, at a minimum:
1. Items inspected
2. Quality characteristics in compliance
3. Quality characteristics not in compliance
4. Corrective/remedial actions taken
5. Statement of certification
6. QC Manager's signature

E. Deficient and Non-conforming Work and Corrective Action: Include procedures for handling deficiencies and non-conforming Work. Deficiencies and non-conforming Work are defined as documentation, drawings, material, equipment, or Work not conforming to the indicated requirements or procedures. The procedure shall prevent non-conformances by identification, documentation, evaluation, separation, disposition, and corrective action to prevent recurrence. Conditions having adverse effects on quality shall be promptly identified and reported to the senior level management. The cause of conditions adverse to quality shall be determined and documented and measures implemented to prevent recurrence. In addition, at a minimum, this procedure shall address:
1. Personnel responsible for identifying deficient and non-complying items within Work.

2. How and by whom deficient and non-compliant items are documented “in the field”.
3. The personnel and process utilized for logging deficient and non-compliant Work at the end of each day onto a deficiency log.
4. Tracking processes and tracking documentation for deficient and non-conforming Work.
5. Personnel responsible for achieving resolution of outstanding deficiencies.
6. Include detailed procedures for the performance and control of special process (e.g. welding, soldering, heat treating, cleaning, plating, nondestructive examination, etc.).

F. Audits: The QA/QC program shall provide for regularly scheduled documented audits to verify that QA/QC procedures are being fully implemented by Contractor and its Subcontractors. Audit records shall be made available to City of Thornton Project Manager upon request.

G. Documented Control/Quality Records:
1. Establish methods for control of Contract Documents that describe how Drawings and Specifications are received and distributed to assure the correct issue of the document being used. Describe how as-built data are documented and furnished to City of Thornton Project Manager.
2. Maintain evidence of activities affecting quality, including operating logs, records of inspections, audit reports, personnel qualification and certification records, procedures, and document review records.
3. Maintain quality records in a manner that provides for timely retrieval and traceability. Protect quality records from deterioration, damage and destruction.
4. Develop a list of specific records as required by the Contract Documents that will be furnished to City of Thornton Project Manager at the completion of activities.

H. Acceptance of QA/QC Plan: City of Thornton Project Manager's acceptance of the QA/QC Plan shall not relieve Contractor from any of its obligations for performance of Work. Contractor's QA/QC staffing is subject to City of Thornton Project Manager's review and continued acceptance. Owner, at its sole option, and without cause, may direct Contractor to remove and replace the QA/QC Representative.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 50 10 - PROTECTION OF EXISTING FACILITIES

PART 1 -- GENERAL

Protect all existing utilities and improvements not designated for removal and restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than prior to such damage or temporary relocation.

1.1 DEFINITIONS

A. Excavation: Any digging, trenching, auguring, backfilling, ditching, grading, plowing-in, pulling-in, ripping, scraping or tunneling.

1.2 RIGHTS-OF-WAY

A. The Contractor shall not do any Work that would affect any oil, gas, sewer, or water pipeline; any telephone, telegraph, or electric transmission line; any fence; or any other structure, nor shall the Contractor enter upon the rights-of-way involved until notified that the Owner has secured authority from the proper party.

B. Copies of encroachment agreements and encroachment requirement for work in existing rights of way are included in the Supplement section of this specification. Implement actions required by those agreements and guidelines.

C. Requirements for work near high voltage overhead power transmission lines are provided as Supplement A to this section. Contractor shall be responsible for taking all necessary precautions and complying with these clearance requirements.

D. After authority has been obtained, Contractor shall give said party due notice of Contractor’s intention to begin work, if required by said party, and remove, shore, support, or otherwise protect such pipeline, transmission line, ditch, fence, or structure, or replace the same.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 PROTECTION OF STREET OR ROADWAY MARKERS

A. Do not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers without proper authorization.

B. No pavement breaking or Excavation shall be started until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced. Survey markers or points disturbed shall be accurately restored after street or roadway resurfacing has been completed.

C. Contractor is responsible for the cleanliness and safety of all roadways adjacent to the construction site. If at any time, these roadways are found to be dangerous or not passable due to debris or mud, local jurisdictions may shut down the project until necessary clean-up is carried out by the contractor at his expense. If clean-up is

deemed to be unsatisfactory or if the local jurisdiction chooses, the local jurisdiction may carry out required clean-up and bill the Owner or Contractor. The Contractor is required to incur the cost of all such clean-up.

3.2 RESTORATION OF PAVEMENT

A. General: All paved areas including asphaltic concrete berms cut or damaged during construction shall be replaced with similar materials of equal thickness to match the existing adjacent undisturbed areas, except where specific resurfacing requirements have been called for in the Contract Documents or in the requirements of the agency issuing the permit. The pavement restoration requirement to match existing sections shall apply to all components of existing sections, including sub-base, base, and pavement. Temporary and permanent pavement shall conform to the requirements of the affected pavement owner. Pavements which are subject to partial removal shall be neatly saw-cut in straight lines.

B. Temporary Resurfacing: Wherever required by the public authorities having jurisdiction, place temporary surfacing promptly after backfilling and shall maintain such surfacing for the period of time fixed by said authorities before proceeding with the final restoration of improvements.

C. Permanent Resurfacing: Contractor shall comply with any agency requirements associated with permanent resurfacing in the jurisdiction that resurfacing is completed. In order to obtain a satisfactory junction with adjacent surfaces, saw cut back and trim the edge so as to provide a clean, sound, vertical joint before permanent replacement of an excavated or damaged portion of pavement. Damaged edges of pavement along Excavations and elsewhere shall be trimmed back by saw cutting in straight lines. All pavement restoration and other facilities restoration shall be constructed to finish grades compatible with adjacent undisturbed pavement.

D. Restoration of Sidewalks or Private Driveways: Wherever sidewalks or private roads have been removed for purposes of construction, place suitable temporary sidewalks or roadways promptly after backfilling and shall maintain them in satisfactory condition for the period of time fixed by the authorities having jurisdiction over the affected portions. If no such period of time is so fixed, maintain said temporary sidewalks or roadways until the final restoration thereof has been made.

3.3 EXISTING UTILITIES AND IMPROVEMENTS

A. Protect underground utilities and other improvements which may be impaired during construction operations, regardless of whether or not the utilities are indicated on the Drawings. Take all possible precautions for the protection of unforeseen utility lines to provide for uninterrupted service and to provide such special protection as may be necessary.

B. Maintaining in Service: Unless indicated otherwise, oil and gasoline pipelines, power, and telephone or the communication cable ducts, gas and water mains, irrigation lines, sewer lines, storm drain lines, poles, and overhead power and communication wires and cables encountered along the line of the Work shall remain continuously in service during all the operations under the Contract, unless other arrangements

satisfactory to the City of Thornton Project Manager are made with the owner of said utilities.

C. Except where the Drawings indicate utilities have been field located during design or certain utility locations will be exposed as part of the Work, make exploratory Excavations as deemed necessary to determine the exact locations and depths of utilities which may interfere with the Work. All such exploratory Excavations shall be performed within a sufficient time in advance of construction to avoid possible delays. Notify the City of Thornton Project Manager if such exploratory Excavations show the noted utility locations to be in error.

D. Utilities to be Relocated: If necessary to relocate the property of any utility owner, coordinate with the utility owner to relocate such property.

E. Underground Utilities Indicated: Existing utility lines that are indicated or the locations of which are made known to the Contractor prior to Excavation and that are to be retained, and all utility lines that are constructed during Excavation operations shall be protected from damage and, if damaged, shall be immediately repaired or replaced, unless otherwise repaired by the owner of the damaged utility. If the owner of the damaged facility performs its own repairs, reimburse said owner for the costs of repair.

F. Underground Utilities Not Indicated: In the event of damages to existing utility lines that are not indicated or the locations of which are not made known to the Contractor prior to Excavation, immediately report the damage to the owner of the damaged utility. Also provide an immediate verbal report of such damage to the City of Thornton Project Manager, to be followed by a prompt written report to both the City of Thornton Project Manager and the utility owner. In the event of damage to existing utility lines affecting any member of the general public, Contractor shall proceed under the conditions set forth in Section 01 14 16 – Public and Media Relations.

G. Approval of Repairs: All repairs to a damaged utility or improvement are subject to inspection and approval by an authorized representative of the utility or improvement owner before being concealed by backfill or other Work.

3.4 UTILITY COORDINATION

A. Contact and coordinate with utility companies regarding protection of existing utilities and special requirements at utility crossing locations and other conditions where the Work is nearby existing utilities. Contractor shall be responsible for all costs of coordination with utilities including but not limited to outages, protection or support and any fees for costs from the utility. Furnish copies of all written agreements obtained by Contractor to the City of Thornton Project Manager.

   a. Allow for three (3) weeks' notice with Xcel Energy, Comcast, and CenturyLink for any relocations. Relocation work will be done once the Contractor has the line exposed.

3.5 TREES OR SHRUBS WITHIN STREET RIGHTS-OF-WAY AND PROJECT LIMITS

A. General: Except where trees or shrubs are indicated to be removed, exercise all necessary precautions so as not to damage or destroy any trees or shrubs, including those lying within street rights-of-way and project limits. Do not trim or remove trees unless so approved by the owner of the tree or shrub and as directed by the City of Thornton Project Manager. Contractor's attention is directed to Section 01 57 19 – Temporary Environmental Controls regarding tree pruning requirements.

B. Trimming: Trimming or pruning of trees shall be performed by a licensed and insured arborist. Symmetry of the tree shall be preserved; no stubs or split or torn branches left; clean cuts shall be made close to the trunk or large branch. Spikes shall not be used for climbing live trees. Cuts over 1-1/2 inches in diameter shall be coated with a tree paint product that is waterproof, adhesive, and elastic, and free from kerosene, coal tar, creosote, or other material injurious to the life of the tree.

C. Replacement: Immediately notify the City of Thornton Project Manager if any tree or shrub is damaged by the Contractor's operations so that the City of Thornton Project Manager may notify the tree or shrub's owner. Replace the tree or shrub if, in the opinion of said owner, the damage is such that replacement is necessary. The replacement tree or shrub shall be of a like size and variety as the one damaged.

3.6 LAWN AREAS

A. Lawn or landscaped areas damaged during construction shall be repaired to match the pre-construction condition to the satisfaction of the land owner and the City of Thornton Project Manager.

3.7 SUPPLEMENTS

A. The supplement(s) listed below, following "End of Section," are a part of this specification:

1. Supplement A, XCEL Energy/Public Service Company of Colorado, High Voltage Electric Transmission Line, Clearance Requirements, For Your Safety.

- END OF SECTION -

SUPPLEMENT A

XCEL ENERGY/PUBLIC SERVICE COMPANY OF COLORADO HIGH VOLTAGE ELECTRIC TRANSMISSION LINE CLEARANCE REQUIREMENTS

FOR YOUR SAFETY

When working near or under a high voltage electric transmission line, it must be assumed the transmission line is energized, and any workers or equipment may not be closer than twenty feet (20') in any direction to the energized transmission lines or conductors. The Xcel Energy/Public Service Company of Colorado Electric Transmission Line Operations Department must be contacted at 303-273-4662 or 303-273-4665 a minimum of 5 days in advance to arrange for a Patrolman to be on site during any construction work within an electric transmission line right-of-way. Safety provisions will allow for operations in accordance with Occupational Safety and Health Act requirements.

When determined to be necessary, the Electric Transmission Line Patrolman will arrange for an outage of the electric lines. Any outage is a day-to-day situation, with the Patrolman on the job site at all times. When the Patrolman has arranged for an outage, any workers must be no closer than three feet (3') in any direction from the de- energized lines or conductors. A fee will be considered on a case-by-case basis if Xcel Energy is on site for an extended period of time.

Under **NO** circumstances may work be started within twenty feet (20') in any direction of the transmission lines or conductors without clearance from the Patrolman. It is the responsibility of the party in charge of the work or contractor to notify the Patrolman whenever starting and ending the work.

When an encroachment of any electric transmission line right-of-way is proposed, it is necessary to request a review of all details to ensure compliance with the National Electric Safety Code. Approved encroachments shall be documented with a fully executed License Agreement. For encroachment review and approval, please call (303) 571-7478.

PLAN AHEAD AND
FOLLOW THESE INSTRUCTIONS - IT COULD SAVE A LIFE

SECTION 01 51 00 - TEMPORARY UTILITIES

PART 1 -- GENERAL

1.1 GENERAL

A. The types of utility services required for general temporary use at the Site include the following:

1. Sanitary facilities

B. Temporary utilities required for the Work shall be arranged by the Contractor and coordinated with the appropriate utilities and agencies. Fees for temporary utility service during construction shall be paid by the Contractor.

1.2 TEMPORARY UTILITIES SCHEDULE

A. In conjunction with establishing the progress schedule, establish a schedule for implementation and termination of service for each temporary utility at the earliest feasible time.

PART 2 -- PRODUCTS

2.1 MATERIALS

A. Provide either new or used materials and equipment, that is in substantially undamaged condition and without significant deterioration and which is recognized in the construction industry by compliance with appropriate standards as being suitable for intended use in each case.

PART 3 -- EXECUTION

3.1 INSTALLATION OF SANITARY FACILITIES

A. Provide fixed or portable chemical toilets wherever needed for the use of Contractor's employees. Toilets at construction sites shall conform to the requirements of Subpart D, Section 1926.51 of the OSHA Standards for Construction.

B. Establish a regular collection schedule for sanitary and organic wastes. Wastes and refuse from sanitary facilities or organic material wastes from any other source related to Contractor’s operations shall be disposed of away from the Site in accordance with laws and regulations pertaining thereto.

- END OF SECTION -

01 53 00 - TREE PROTECTION

PART 1 -- GENERAL

1.1 DESCRIPTION OF WORK

A. This work shall consist of taking the necessary precautions to protect any trees within the project. It shall not include trees that are within the permanent easement, whose removal is required to complete the project. These trees do not need to be protected or replaced.

1.2 DEFINITIONS

A. Tree Protection Zone: The Tree Protection Zone is a critical root zone and shall be a disturbance free area. A Tree Protection Zone shall be established for each tree 4" in caliper and greater. Caliper shall be defined as the maximum diameter of the trunk 4.5' above the ground. The Tree Protection Zone shall be a circle with a radius relative to the caliper of the tree. The radius shall be one linear foot in length for each inch of tree caliper and the center of the circle shall be the trunk of the tree. (For Example: If the tree has a trunk twelve inches (12") in diameter then the disturbance free zone shall have a radius of twelve feet (12') from the center of the tree.)

B. Disturbance Trenching: Disturbance trenching shall be defined as any changes in grade either cut or fill, material or equipment storage, equipment movement, compaction or paving.

PART 2 -- PRODUCTS

2.1 MATERIALS

A. "Orange" safety fencing is required for use in tree protection and is to be installed around the tree protection zone of all trees designated for protection. Fencing shall be maintained daily and remain in place until project completion. A minimum of five (5) metal T-stakes per tree shall be used to delineate the Tree Protection Zone.

PART 3 -- EXECUTION

3.1 SOIL EXCAVATION AROUND TREES

A. Equipment of any kind is prohibited from operation within the Tree Protection Zone of all trees – this includes vehicle parking and foot traffic.

B. Stock piling of soil or materials is prohibited within the Tree Protection Zone of all trees.

C. Compacting of the soil is prohibited within the Tree Protection Zone of all trees.

D. Trenching and excavation is prohibited within the Tree Protection Zone of all trees, unless approved prior to construction.

E. Any root pruning that is approved within the Tree Protection Zone shall be performed with a sharp tool and a clean cut.

F. Roots shall not be exposed to the air for more than two to four (2-4) days, in order to avoid drying out and death.

G. Limb damage is prohibited, unless approved prior to construction or as authorized by the Project Manager. Pruning of interfering limbs shall be done prior to construction and must be accomplished by a company licensed to perform tree work within the City of Thornton. A list of authorized companies can be obtained from the Project Manager.

H. Damage to the main trunk of the tree is prohibited. Damage greater than ten percent (10%) of the main trunk, not resulting in structural damage shall result in a fine based on the percentage of the circumference affected. Damage greater than thirty percent (30%) of the circumference of affecting structural integrity of the tree will result in a fine equal to the full-appraised value of the tree.

I. All concrete washout areas must be designated – they shall not flow into or across the Tree Protection Zone.

J. If irrigation is interrupted for more than one week, trees will require supplemental watering methods. Water should be evenly distributed within the critical root zone. As a rule, ten (10) gallons of water per one inch (1”) of trunk diameter should be administered.

- END OF SECTION -

SECTION 01 55 00 - SITE ACCESS AND STORAGE

PART 1 -- GENERAL

1.1 CONTRACTOR'S WORK AND STORAGE AREA

A. Staging areas are shown on the Drawings. Staging areas are for the exclusive use by the Contractor during the term of the contract as a storage and shop area for its construction operations on the Work. At completion of the work return these areas to their original condition, including grading and landscaping, unless otherwise shown.

B. Maintain a separate area within the staging area for hazardous materials used in constructing the Work.

1. For the purpose of this paragraph, hazardous materials to be stored in the separate area are products labeled with any of the following terms: Warning, Caution, Poisonous, Toxic, Flammable, Corrosive, Reactive, or Explosive. In addition, whether or not so labeled, the following materials shall be stored in the separate area: diesel fuel, gasoline, new and used motor oil, hydraulic fluid, cement, paints and paint thinners, 2 part epoxy coatings, sealants, asphaltic products, glues, solvents, wood preservatives, sand blast materials, and spill absorbent.
2. Hazardous materials shall be stored in groupings according to the Material Safety Data Sheets.
3. Obtain and submit to the City of Thornton Project Manager a single EPA number for wastes generated at the Site.
4. The separate storage area shall meet the requirements of authorities having jurisdiction over the storage of hazardous materials.
5. Hazardous materials that are delivered in containers shall be stored in the original containers until use. Hazardous materials delivered in bulk shall be stored in containers which meet the requirements of authorities having jurisdiction.

1.2 PARKING

A. The Contractor shall direct its employees to park in areas requested by the City of Thornton Project Manager.

B. Traffic and parking areas shall be maintained in a sound condition, free of excavated material, construction equipment, mud, and construction materials. The Contractor shall repair breaks, potholes, low areas which collect standing water, and other deficiencies.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 55 26 - TRAFFIC CONTROL

PART 1 -- GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. AASHTO Roadside Design Guide, Current Edition.
2. Manual on Uniform Traffic Control Devices (MUTCD), Current Edition.
3. Federal Highway Administration. Standard Highway Signs.
4. ATSSA: American Traffic Safety Services Association. Quality Standards for Work Zone Traffic Control Devices.
5. NCHRP – Report 350 Recommended Procedures for the Safety Performance Evaluation of Highway Features.
6. Colorado Department of Transportation (CDOT), Standard Specifications for Road and Bridge Construction (Standard Specifications).

1.2 SUBMITTALS

A. Administrative Submittals: Copies of permits, licenses, and approvals for construction as required by Laws and Regulations and governing agencies.

B. Shop Drawings:

1. Approved Traffic Control and Routing Plans: As specified herein.
2. Message Boards: Proposed locations for placement at each detour or road closure.

C. Traffic Control Supervisor(s) Qualifications: Qualifications of proposed traffic control supervisor(s) and traffic control plan signatory.

1.3 TRAFFIC CONTROL SUPERVISOR

A. The traffic control supervisor shall be responsible for initiating, installing, and maintaining all traffic control devices as shown on the Traffic Control and Routing Plans, and as specified in the MUTCD and these specifications, or as directed. The traffic control supervisor shall be an employee of the Contractor and shall be assigned full time to the Project while work is underway on public roadways. The designated traffic control supervisor shall also be available to be contacted by the City of Thornton Project Manager 24 hours a day for the life of this contract. The persons so designated shall have at least one year of experience directly related to Work site traffic control in a supervisory capacity and shall be certified as a Work site traffic control supervisor by ATSSA. Submit the name and qualifications of this person for review 7 days in advance of the date set for the preconstruction conference.

B. The traffic control supervisor shall be capable of being onsite within 45 minutes of notification. The traffic control supervisor shall make at least four inspections of all

traffic control devices each day as follows:

1. Before beginning work.
2. At mid-shift.
3. Half an hour after the end of the shift.
4. Once during the period of nonworking hours.

C. The traffic control supervisor shall make a daily record of traffic control activities using a form provided to and approved by the City of Thornton Project Manager. Submit completed forms within 24 hours.

D. The traffic control supervisor shall oversee the security of the message boards to be implemented by the Contractor's field staff. Security measures shall be implemented daily and shall include locking the programming consoles, removing the tires, locking the tires to the message boards, chaining the message boards to a fixed item, and other measures to prevent theft.

E. Each day the traffic control supervisor shall develop the messages for the message boards, determine the locations of the message boards, coordinate with field labor to locate the message boards, and program the message boards.

F. The traffic control supervisor shall oversee the flagging operations. For road closures, the traffic control supervisor shall prepare informational handouts showing schedules and maps of crew locations to be provided to the City of Thornton Project Manager for distribution by the Public Involvement Coordinator. The traffic control supervisor shall manage the distribution of radios to flaggers, and oversee the proper functioning of radios.

G. Each evening and morning, signs shall be covered and uncovered as needed to inform the public of roadway closures, detours, work zones, and other traffic information. Each evening just before crews leave, all signs not required shall be covered and all signs required shall be uncovered. Each morning before start of construction, all signs not required shall be covered and all signs required shall be uncovered. The traffic control supervisor shall oversee the covering and uncovering of signs each evening and morning.

H. Traffic control supervisor shall oversee storage of materials and construction equipment along right-of-way, as needed to ensure compliance with the Contract Documents. Refer to Section 01 60 00, Products, Materials, and Equipment, for storage requirements and Section 01 50 10, Protection of Existing Facilities, for protection of Work and property.

I. Traffic control supervisor shall be responsible for verifying that property owner notifications are made in accordance with Contract requirements.

1.4 FLAGGER

A. Flaggers must have a current flagging certificate and must present proof of the following certifications upon request by the Department.

1. Acceptable certifications.

2. CDOT Contractor Certification.

3. American Traffic Safety Services Association (ATSSA).

1.5 TRAFFIC CONTROL AND ROUTING PLANS

A. The Traffic Control and Routing Plans shall be prepared and/or certified as to conformance with these Specifications by a Professional Traffic Operation Engineer (PTOE) or an ATSSA certified Work Site Traffic Control Supervisor and shall include the PTOE registration number or ATSSA certification number of the certifying person.

B. Submit the initial phase Traffic Control and Routing Plans at the preconstruction conference. Submit plans for future phases of construction a minimum of 28 days before start of that construction phase to allow review and resubmittal, if necessary, and public notification. Meet with the City of Thornton Project Manager and affected agency having jurisdiction to review each of the Traffic Control and Routing Plans for each phase of construction. Do not begin construction on any given phase before receiving written acceptance from the affected agency having jurisdiction.

C. Failure to submit the Traffic Control and Routing Plans within the specified time frames will not be justification for additional working days. Failure to adequately address comments in any required resubmittal also will not justify additional working days.

D. Changes to this plan shall be made only by written approval of City of Thornton Project Manager. Secure approvals for necessary changes so as not to delay progress of the Work.

E. If multiple road closures are desired simultaneously, detours must be coordinated and approved in advance by the City of Thornton Project Manager and the agency or agencies having jurisdiction. Allow a minimum of 14 days for the City of Thornton Project Manager and the agency or agencies having jurisdiction review followed by 14 days of prior notification of residents. Multiple simultaneous road closures will require additional message boards (at each end of the closure) for duration of simultaneous closures.

F. Traffic Routing Plan: Show sequences of construction affecting the use of roadways, time required for each phase of the Work, provisions for decking over excavations and phasing of operations to provide necessary access, and plans for signing, barricading, and striping to provide passages for pedestrians, bicycles, and vehicles. Include schedule for covering traffic control signs (including detour signs) when not in use and uncovering just prior to use.

G. The Traffic Control Plans in the Contract Documents are guidelines only, and shall not be used in lieu of detailed Contractor-prepared plans. Detailed Traffic Control Plans shall show the locations of traffic cones, barrier rail, construction zones, flaggers, stored pipe and materials, construction truck access, barricades, detours, signs, message boards, and other traffic control facilities.

H. On a time and day agreed upon between the Contractor and City of Thornton Project Manager, meet weekly with the City of Thornton Project Manager to describe the

following week's construction operations and the traffic control provisions. At each meeting, submit a detailed update of traffic control provisions and construction crew locations. This shall be submitted in hardcopy and electronic form using a Word file. The update shall contain a list of signs and the time and location for covering and uncovering signs. The update shall include the location and wording of message control boards.

I. See Section 01 14 00, Construction Constraints, for construction scheduling constraints.

J. Message boards shall be required for road closures, detours and as required by applicable jurisdictions.

PART 2 -- PRODUCTS

2.1 CERTIFICATIONS

A. Use devices and systems which meet NCHRP-350 Report crash test requirements as defined in the four categories by the Federal Highway Administration. Some exceptions will be acceptable as stated below.

1. Category 1: Cones, tubular marker, delineators, and drums without lights must be certified by the manufacturer as meeting NCHRP-350 Report requirements.

2. Category 2: Portable sign stands with signs, Type I, II and III barricades, vertical panels, Category 1 devices with light attachments and devices not expected to cause significant vehicle velocity change. These devices and systems must be certified by FHWA as meeting NCHRP-350 Report test requirements.

3. Category 3: Portable/Temporary pre-cast concrete barrier manufactured after October 1, 2002 must be certified as meeting NCHRP-350 Report test requirements:

   a. Manufactured date to be stamped into top of each barrier section using a numeric format (ex: 10/2002) with 2 inch x 2 inch numerals, 1/4 inch deep. See Standard Drawing BA 1A and BA 2.

   b. Portable/Temporary pre-cast concrete barrier manufactured prior to October 1, 2002 and meeting NCHRP 230 may be used until they are no longer serviceable.

4. Category 3: Crash Cushions and Truck Mounted Attenuators must be certified by FHWA as meeting NCHRP-350 Report test requirements.

5. Category 4: Advanced Warning Arrow Panels and portable variable message signs do not have to meet NCHRP-350 Report test requirements.

2.2 FLAGGER EQUIPMENT AND CLOTHING

A. Comply with CDOT "Flagger Training Handbook."

B. Comply with Traffic Control Drawings.

C. Paddle: Use combination "STOP" and "SLOW" sign paddles, a minimum of 18 inches wide, with 6-inch series "C" letters, and a rigid fixed handle approximately 5 feet in

length from the bottom of the paddle to ground level. Fabricate the combination sign paddle from sheet metal or other light semi-rigid material. The background of the "STOP" face shall be red with white letters and border. The background of the "SLOW" face shall be orange with black letters and border. Use Type II reflective sheeting for the background, letters, and border on the faces of the Stop/Slow paddles.

D. Clothing:

1. Flagger vest and hard hat: Orange, red-orange, or fluorescent version of these colors:
   a. Safety vest, with a minimum of 775 inches of background material. Night work requires a minimum of 200 inches of reflective material (100 inches on the front and 100 inches on the back). Reflective material will be white and/or strong yellow-green.
   b. Hard hat with 10 inches of white or strong yellow-green reflective tape placed around the base of the hard hat and visible to traffic from all directions.

2.3 TRAFFIC CONTROL SIGNING AND DEVICES

A. Signs:

1. Comply with this Section, Article CERTIFICATIONS.
2. Comply with CDOT Standard Specifications, Section 630.02, Signs and Barricades.
3. Comply with Contract Plans traffic control sheets.

B. Channelizing Devices:

1. Comply with Article CERTIFICATIONS.
2. Comply with Traffic Control Drawings.
   a. Comply with CDOT Standard Specifications, Section 630, Construction Zone Traffic Control.
   b. Use construction orange tubular markers and cones during daylight hours only.

C. Barricades:

1. Comply with Article CERTIFICATIONS.
2. Comply with Traffic Control and Routing Plans.
3. Do not use rocks, asphalt, or concrete pieces, construction materials, and other debris as weighting devices for barricades. Sand bags will be permitted as long as a low center of gravity is maintained as approved.

D. Precast Concrete Barrier:

1. Comply with Article CERTIFICATIONS.
2. Comply with contract Traffic Control and Routing Plans.
3. Use an approved construction zone attenuator or permanent style end sections, as listed in CDOT Guidelines for Attenuators and End Section.

a. Use a construction zone attenuator when approach ends of temporary precast barrier are within AASHTO clear zone.
b. Use AASHTO Roadside Design Guide to determine proper clear zone distance requirements.
c. Install crash cushions as per contract traffic control sheets and manufacturer's recommendations.

4. Do not use a truck mounted attenuator (TMA) to protect temporary precast barrier end for more than 24 hours. Use properly rated TMA as directed in this Section.

E. Impact Attenuator: Use properly rated truck mounted attenuator for the posted speed limit prior to construction.

1. NCHRP-350 Test Level 2 for speeds 45 mph or less.
2. NCHRP-350 Test Level 3 for speeds greater than 45 mph.

2.4 ADVANCE WARNING ARROW PANEL

A. Advance Warning Device:

1. Meet all standards as specified in the MUTCD, Section 6F.53 Arrow Panels.
2. Perform all functions as specified in contract traffic control plan sheets and the MUTCD.
3. Provide as shown on drawings and in sufficient quantity to safeguard public and Work.

PART 3 -- EXECUTION

3.1 LIMITATIONS OF OPERATIONS

A. Limits of operations are as shown on the drawings.

B. Hours of operations are as shown on the drawings.

C. A maximum of 15 percent vertical profile grade shall be constructed and maintained at all times in order to accommodate public traffic.

D. Conduct traffic control in accordance with the approved Traffic Control and Routing Plans and the MUTCD.

E. Allow emergency vehicles immediate passage when maintaining partial roadway closures.

F. Minimum lane width shall be 10 feet, unless noted otherwise. Where cones are used to separate traffic lane from construction zone, do not use traffic lane for accessing construction zone, and do not store materials or equipment on or near shoulder of traffic lane side of roadway.

G. Whenever it is necessary to cross, close, or obstruct driveways and walks, whether public or private, provide and maintain suitable and safe bridges, detours, or other temporary expedients for accommodation of public and private travel.

H. Driveway and Private Road Closures: Maintain satisfactory means of exit for persons residing or having occasion to transact business along the route of the Work. When access to private driveways must be temporarily denied due to construction operations, notify the property owner or responsible party of such closure not less than 24 hours in advance of closure. Give notification in writing and include the estimated duration of the closure.

I. In making street crossings, do not block more than one-half the street at a time. Maintain one lane of traffic at all times. Ensure access for traffic in both directions.

J. Notify the fire department, police/sheriff department, highway patrol, ambulance service, local school district, and transit 14 days before closing roadway or portion thereof. Notify said departments or agencies when streets are again passable for vehicles. Conduct operations with the least interference to fire equipment access, and at no time prevent such access. Furnish Contractor's night emergency telephone numbers to the police or sheriff's department.

K. If Work will interfere with mail delivery, move mailboxes to temporary locations accessible to postal service, and on completion of Work in each area, replace them in their original location and in a condition equal to or better than original. When access to private driveways must be temporarily denied due to construction operations, notify the property owner or responsible party of such closure not less than 24 hours in advance of closure. Give notification in writing and include the estimated duration of the closure.

L. If Work will interfere with garbage pickup, move property owner's (resident's) garbage cans to areas accessible for garbage pickup. Garbage cans shall be returned to owner's driveway after pickup.

M. Pedestrian and bicycle access along sidewalks and streets will be kept open and safe from construction activities.

N. Coordination: Coordinate traffic routing with that of others working in the same or adjacent areas. Coordinate access for garbage pickup, mail delivery, and school buses.

O. Each evening prior to crew departure, all Work areas shall be swept to ensure all construction debris (including, but not limited to, AC waste, gravel, and dirt) has been removed from the surface of the road. Debris shall be disposed of offsite and shall not be swept into ditches or otherwise outside of the Work area.

P. Barricades and Lights:

1. Provide as shown on drawings and in sufficient quantity to safeguard public and Work.

2. Provide as necessary to prevent unauthorized entry to construction areas and affected roads, streets, and alleyways, inside and outside of fenced area, and as

required to ensure public safety and the safety of Contractor's employees, other employer's employees, and others who may be affected by the Work.

3. Provide to protect existing facilities and adjacent properties from potential damage.
4. Locate to enable access by facility operators and property owners.
5. Protect streets, roads, highways, and other public thoroughfares that are closed to traffic by effective barricades with acceptable warning signs.
6. Locate barricades at the nearest intersecting public thoroughfare on each side of the blocked section.

Q. Signs and Equipment:

1. Traffic control signs and equipment shall be as described herein, the MUTCD and the Standard Highway Signs, shown on Traffic Control Details, and as directed by City of Thornton Project Manager.
2. Contractor shall maintain existing traffic control signs during construction.
3. Portable TOW-AWAY-NO STOPPING Signs: Place where approved by police department of the agency having jurisdiction and the Owner.
4. Business Access Signs: Place at accesses to businesses in the vicinity of construction activities.
5. Traffic Cones: Provide to delineate traffic lanes to guide and separate traffic movements. Provide at obstructions, such as material piles and equipment, as directed by City of Thornton Project Manager.
6. Illuminate barricades and obstructions with warning lights from sunset to sunrise, or as directed by City of Thornton Project Manager.
7. Use to alert general public of construction hazards, which would include surface irregularities, un-ramped walkways, grade changes, and trenches or excavations in roadways and in other public access areas.
8. Post-mount informational signs both sides of detour 14 days before detouring any traffic as to the date, time, and duration of the detour. Sign shall be stenciled with 6-inch black letters on an orange background. Signs shall meet these specifications.
9. Place solar powered barricade-type lights on Road Work Ahead signs and construction speed limit signs.
10. All portable and night use signs shall use “diamond” grade reflective lettering.
11. Detour signs shall be covered when not in use and uncovered just prior to use. Detour signs shall be covered with wood or metal. The use of easily displaced material such as plastic bags, burlap sacks, duct tape, etc. is not acceptable.
12. Each sign or piece of equipment shall be certified by the manufacturer to meet the requirements of this Specification. Any sign or equipment which is damaged, or appears to be in poor condition, must be re-certified by the manufacturer. The City of Thornton Project Manager shall be the sole judge as to whether used signs or equipment supplied under this Contract need re-certification.

- END OF SECTION -

SECTION 01 57 19 - TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 -- GENERAL

1.1 GENERAL REQUIREMENTS

A. All known environmentally or culturally / historically sensitive sites have been identified by the City. Wildlife locations can change; therefore, sites will be “cleared” by the City prior to any construction. This clearance process will be completed by the City approximately 2 weeks to 30 days prior to any construction activities planned by the Contractor. Any delays to the Contractor’s critical path schedule caused by the unanticipated presence of wildlife protected under the Endangered Species Act, Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act shall be considered a differing site condition. Contractor-initiated changes to the approved critical path schedule may require a change in the sequence of CES’ environmental clearance operations. Delays or limitations of Contractor’s work caused by Contractor-initiated changes to the approved critical path schedule, and resulting changes in sequencing of environmental clearance activities, will not be considered as differing site conditions.

B. Comply with the requirements for management of hazardous substances used by the Contractor.

1.2 DEFINITIONS

A. Hazardous Substances: Hazardous Substances include potentially dangerous or toxic substances, in whatever form or state, or contained in environmental media (e.g., contaminated soil), that are known or suspected to adversely affect the health and safety of humans, animals, plants, or organisms, or which are known or suspected to impair the environment in any way whatsoever. Hazardous substances specifically include elements and compounds identified in the Section 101(14) of the Comprehensive Environmental Response, Compensation and Liability Act (40 CFR 302.4), and Section 311(b)(2)(A) of the Clean Water Act (40 CFR 116.4); materials defined, designated or listed under United States OSHA; or any other Federal, State or local law, regulation or ordinance concerning hazardous material or waste, toxic substances or pollution including but not limited to the following:

1. Asbestos: Means any material that contains more than one percent asbestos and is friable or releasing asbestos fibers into the air above current action levels established by United States OSHA.
2. Contaminated or suspected contaminated soil – soil that contains or is likely to contain the hazardous substances included in the definition.
3. Hazardous Waste: Any waste material that meets the definition of “hazardous” as defined in 40 CFR 261.
4. Hazardous Material: A substance or material regulated for transport by the Department of Transportation, and defined in 49 CFR 171.8.
5. Petroleum: Includes crude oil or any fraction thereof which is liquid such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-hazardous wastes.

B. Environmental Compliance Officer (ECO): The ECO shall be employed by the Contractor, and shall be responsible for coordinating compliance with the requirements of Federal, State of Colorado, and local requirements, as described herein, and as required by the various permits and by law. The ECO is the primary liaison between the Contractor and the City of Thornton Project Manager.

C. Health and Safety Officer (HSO): The HSO shall be employed by the Contractor and have experience in chemical-related health and safety.

1.3 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00, Contractor Submittals.

B. Provide for removal, mitigation, and remediation of any contaminated soils or water, where such contamination is a direct result of Contractor's action. Hazardous materials that are encountered during construction that were unknown to the City or the Contractor shall be removed, mitigated, or remediated by the City. In the event that such materials are encountered during construction, the City may elect to request a quote from the Contractor to provide remediation services pursuant to a differing site condition.

C. Environmental Protection Plan (EPP): Prior to commencing construction activities or delivery of materials to the project site, the Contractor shall submit an EPP for review and approval to the City of Thornton Project Manager. Issues of concern to each construction activity and the Contractor's mitigating measures shall be identified and defined within the EPP.

1. Compliance: No requirement in this section shall be construed as relieving the Contractor of the obligation to comply with any applicable Federal, State of Colorado, or local environmental laws or regulations. The Contractor shall be responsible for identifying any additional issues during construction, and proposing any additional measures required to address the additional issues identified. The Contractor shall submit the proposed additional measures as addenda to the EPP, and implement the measures when approved.

2. Contents: The EPP shall include, but not be limited to the following:

a. Name(s) and environmental experience and qualifications of ECO and other person(s) within the Contractor's organization responsible for ensuring compliance with the EPP.

b. Description of Contractor's stop work authority and procedures as they relate to environmental protection.

c. Description of the Contractor's communication protocol and procedures for coordinating with the City of Thornton Project Manager, to ensure ongoing compliance with environmental requirements and the identification and resolution of environmental issues as may be required during the course of the work.

d. Description of Contractor's plan for obtaining all erosion and sediment control permits from the appropriate local and State jurisdiction, and for complying with the requirements of the permits, and the erosion and sediment control plan. The Drawings include an erosion and sediment control plan, which identifies some of the grading, erosion and sediment

controls that must be implemented pursuant to State and local permits and requirements. The Contractor's attention is directed to Specification 01 41 26 Permits and Agreements for more information.

e. Drawings showing locations of proposed temporary excavations, haul/construction roads, construction entrance/exits, material storage areas, structures, sanitary facilities, equipment/material lay-down areas, and stockpile locations for excess or spoil materials including methods to control runoff. Contractor may elect to prepare these drawings on the grading, erosion, and sediment control drawings included in the bid documents, or on separate sheets.

f. Traffic control plans including measures to reduce erosion and prevent sediment or other materials from entering any Waters of the United States as defined by 33 CFR Part 328 and supplementary information (includes wetlands, streams, and intermittent channels). The plan shall include measures to prohibit and physically prevent (e.g., through barrier fencing) vehicles or equipment from entry into any Waters of the United States for any purpose, including temporary crossings. This plan must be consistent with any traffic control plans which may be included in the bid documents.

g. Spill Prevention, Control and Countermeasures (SPCC) Plan: The SPCC Plan which shall include procedures, instructions, and reports to be used in the event of a spill or release of oil or a hazardous or regulated substance by the Contractor.

h. Materials Management Plan: This plan shall include procedures for the following:

   i. Waste Identification/Characterization: Include sampling and analysis procedures.
   ii. Onsite management and offsite transportation and disposition of contractor-generated contaminated and hazardous wastes.
   iii. Non-hazardous solid waste management and disposal, including provisions for soil reuse and for the disposition of uncontaminated clearing debris, and construction and demolition debris.
   iv. Hazardous Substances:
      a) General process for communicating to the City of Thornton Project Manager that will be followed when unknown hazardous substances are encountered during the course of construction.
   v. Containment and disposition of contaminated or potentially contaminated excavation water, wastewater, or decontamination water, generated by the Contractor.
   vi. Monitoring procedures to identify when Hazardous Substances are encountered during construction.

i. Fugitive dust control plan with provisions for ensuring that dust, debris, materials, trash, etc. do not become airborne during construction projects, pursuant to the requirements of the Contractor's Air Pollution Emissions Notice for the Project.

j. Hazardous materials inventory that identifies potentially hazardous substances to be used on the job site. A copy of the Material Safety Data Sheets shall be available at the job site.

k. Procedures and measures for protecting and preventing any physical intrusions into and contamination of areas that are outside of the construction limits for the Project.

l. Description of the ECO's plan for training Contractor's project staff and subcontractors, to ensure that they are prepared to conscientiously implement the approved EPP.

1.4 ENVIRONMENTAL PROTECTION REQUIREMENTS

A. Waters of the U.S., Including Wetlands – Best Management Practices and Construction Specifications:

1. Best Management Conditions for all other Waters of the United States

a. Construction plans will include best management practices (BMPs) and specifications to ensure that construction of Project facilities, including mechanized land clearing or excavation, avoid the discharge of dredged or fill material in any wetlands or waters subject to the Corps' jurisdiction under Section 404 of the CWA. Using construction and/or sediment fencing (see Drawings), the construction area involving jurisdictional wetlands or waters will be clearly delineated in the field by the Contractor.

b. The Contractor will be responsible for installing, maintaining and removing all sediment/construction fencing required around wetlands and waters.

c. For each special crossing involving jurisdictional wetlands or waters, the Drawings clearly delineate the boundary of the wetlands and waters. Contractor shall prevent any entry or discharges into jurisdictional wetlands or waters.

i. Construction contractor shall not perform any work, store any equipment or materials, or otherwise disturb the ground surface between construction fencing and stream or wetland.

ii. Temporary dewatering shall be in compliance with Colorado Department of Public Health and Environment (CDPHE) regulations and State of Colorado Water Quality Standards.

iii. Equipment maintenance and washing will be performed only in approved areas that do not drain directly to waters of the United States.

iv. All equipment fueling, maintenance and other activities that could result in petrochemical spills shall be performed in compliance with an approved SPCC.

v. Erosion and sediment will be controlled as specified in the sediment and erosion control plan and report, and shall be in compliance with CDPHE and local regulations.

vi. No vehicles, construction equipment or materials shall be allowed to enter or drive through jurisdictional wetlands or streams.

B. Wildlife

1. After July 15th and prior to March 1st of any year, Contractor shall perform vegetation clearing such as mowing, shrub cutting, and brush cutting in all areas which will have active construction occur during the period of March 1st and July 15th that year. The purpose of this clearing is to prevent non-raptor migratory

birds from nesting within the area of active construction. Cleared vegetation must be initially cleared to a height of 4" of less prior to March 1st and be maintained to a height of 4" or less between March 1st and July 15th. Debris resulting from vegetation clearing does not have to be removed initially upon clearing activity, but shall be removed by the Contractor prior to the completion of construction. During the period of March 1st and July 15th, the Contractor's work shall be restricted to areas cleared prior to March 1st. Delays, limitations of Contractor's work, and additional costs resulting from Contractor's failure to perform this work as stated will not be considered as differing site conditions. Should active migratory bird nests be discovered, the City will mitigate such discovered nests to continue to allow the Contractor unrestricted access to construction areas in accordance with the Contractor's approved critical path schedule and to the extent that such mitigation is allowed by the Colorado Division of Wildlife.

2. Bald Eagles: While bald eagles are considered raptors, they are afforded additional legal protections under the Bald and Golden Eagle Protection Act. This law is administered by the U.S. Fish and Wildlife Service and Colorado Division of Wildlife.

    a. Construction within the restricted ½-mile bald eagle nest buffer shown on the drawings is only allowed from August 15th to October 15th of any year. Contractor shall not plan or conduct any construction activities, except land management and revegetation activities as described below, within the restricted ½-mile bald eagle nest buffer shown on the drawings before August 15th and after October 15th of any year. Delays, limitations of Contractor's work, and additional costs resulting from Contractor's failure to perform construction activities, except land management and revegetation activities as described below, within the eagle nest buffer shown during the allowed period will not be considered as differing site conditions.

C. Cultural Resources

1. The Contractor's ECO shall monitor the work areas for potential cultural or historic resources if bones or artifacts (historic or prehistoric) are discovered during ground disturbing activities:

    a. Stop Work and delineate the apparent limits of the cultural resource using flagging tape or other means to prevent continued disturbance.

    b. Immediately inform the City of Thornton Project Manager of potential cultural resource discoveries.

    c. The City of Thornton Project Manager will contact a qualified archaeologist or the State Historic Preservation Office (SHPO) to evaluate cultural resource discoveries. If the bones are determined to be human, City of Thornton Project Manager will contact the county coroner and sheriff.

    d. Any delays to the Contractor's critical path schedule caused by discovery of unknown cultural resources shall be considered a differing site condition, as described in Article 4.03 of the General Conditions.

D. Hazardous Substances

1. No areas of known or suspected hazardous substance contamination have been identified on the Project Site.
2. If contaminated soils, suspected contaminated soils, or other indicators of potential hazardous substance contamination including buried or discarded drums or containers, underground storage tanks, or suspicious liquid or solid lenses are uncovered during excavation:
    a. Stop Work and immediately notify the City of Thornton Project Manager.
    b. Delineate the apparent limits of contamination using flagging tape or other means to prevent entry.
    c. City of Thornton Project Manager will notify the City, who shall be responsible for excavation, stockpiling, and disposal of contaminated soils.
3. Any delays to the Contractor's critical path schedule caused by discovery and subsequent remediation of hazardous substance contamination not attributable to Contractor shall be considered a differing site condition, as described in Article 4.03 of the General Conditions.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 ENVIRONMENTAL COMPLIANCE OFFICER

A. Environmental Compliance Officer (ECO): Appoint an ECO for the construction project. The ECO will be responsible for coordinating compliance with the Contract Documents, with requirements and laws of Federal, State of Colorado, and local jurisdictions, and with requirements of the various permits. The ECO is the primary liaison between the Contractor and the City of Thornton Project Manager. The City of Thornton Project Manager shall advise the need to stop work if he or she determines that an activity will cause a violation of an environmental law or regulation.
    1. The ECO shall have a minimum of 2 years of experience with environmental controls and compliance with environmental requirements, specifically with hazardous materials/waste management, and spill prevention and response.
    2. The ECO shall be responsible for coordinating with the Contractor's staff, including subcontractors, to ensure that they receive appropriately detailed training so they will be prepared to conscientiously implement the approved EPP. All employees or subcontractors shall be trained by the ECO, following review of the training plan by the City of Thornton Project Manager, prior to the start of construction. The ECO shall be responsible for assuring and verifying that all employees hired following the commencement of construction receive the same level of training as was provided prior to the start of construction. The ECO will consult with the City of Thornton Project Manager on an ongoing basis (at minimum quarterly) to obtain any updated environmental management information, prior to undertaking any subsequent training.
    3. The ECO shall be responsible for ensuring compliance with the EPP, and requirements of all SPCC, materials management plans, and storm water discharge/erosion control permits:

a. Ensure that BMP and requirements for Erosion and Sediment Control Plan (ESC, included in the Drawings) are properly implemented.

b. Perform and document regular (at least bi-weekly) storm water inspections or identify qualified inspector, and document his or her qualifications.

c. Maintain inspection records within a well-organized and up-to-date Environmental Records management system.

d. Ensure that ESC best management practices/features are maintained throughout all phases of construction.

4. The ECO shall monitor the work areas as identified in section 1.4 ENVIRONMENTAL PROTECTION REQUIREMENTS and advise the City of Thornton Project Manager of culturally, historically, or environmentally sensitive sites.

3.2 ACCESS AND TEMPORARY FENCING

A. Access Route and Transportation Restrictions: Contractor's access to and from the Site and within the Site shall be within the areas identified as construction limits on the Drawings. The Contractor shall not permit driving across or transporting equipment or materials across areas outside of the construction limits on the Drawings. Verify proposed access routes with the City of Thornton Project Manager at least 30 days prior to the commencement of Work.

B. Temporary Construction Limits Fencing: Install and maintain fencing as indicated on the Drawings. Install perimeter fencing along the edges of Contractor-acquired access roads that were not indicated on the Drawings.

1. Fencing may be installed all at one time or in phases along portions of the entire site so long as it encompasses the active construction areas including staging areas and topsoil stockpiles.

2. Fencing may be installed all at one time or in phases along access to site(s) delineated by property owner and coordinated by the City.

3. Fencing shall be inside the boundaries of the designated working areas, and inside any prairie dog/burrowing owl visual screen fences installed by the CES at or near easement lines as indicated. The fencing shall be installed such that the Contractor does not disturb the ground outside of the fence line. Moving installation equipment outside of the fenced area shall only be allowed if approved in advance by the City of Thornton Project Manager.

C. Temporary Stormwater Control Best Management Practices (BMPs), including but not limited to Silt Fencing: The Contractor is responsible for properly locating, installing and maintaining all required BMPs, and removing them after completion and acceptance of revegetation. Install and maintain all BMPs shown on Drawings in conformance with the Stormwater Management Plan and CDPHE Construction Stormwater Discharge Permit. Where silt fencing or other BMPs are shown along or near other required temporary fencing such as temporary security fencing, construction limits fencing, or prairie dog/burrowing owl visual screen fencing, install BMPs two feet inside of temporary fencing.

1. Maintain all BMPs regularly during construction until acceptance of revegetation. Immediately repair BMPs damaged during construction prior to continue construction activity.
2. Regular maintenance shall include but not be limited to the following: removal of trash and sediment accumulation from BMPs, and repair of any damage.
3. Remove and dispose of all BMPs following acceptance of revegetation.

3.3 DUST CONTROL

A. Comply with dust control requirements in the Colorado Department of Public Health and Environment's Air Pollution Emission Notice (APEN) permit in the Supplement of Section 01 41 26, Permits, and the following.

B. Carry out effective measures wherever and as often as necessary to prevent operations from producing dust in amounts damaging to property, cultivated vegetation, or domestic animals, or causing a nuisance to persons living in or occupying buildings in the vicinity. The Contractor shall be responsible for any damage resulting from any dust originating from its operations.

C. Apply non-toxic soil stabilizers according to the product manufacturer's recommendations to inactive construction areas or water at least twice daily, or more often, as needed, to maintain adequate dust control.

D. Enclose, cover, water at least twice daily or more frequently as needed or apply non-toxic soil binders according to the product manufacturer's recommendations to exposed piles of material (i.e. gravel, sand, dirt) with a silt content of 5 percent or greater.

E. Water active construction sites and unpaved roads at least twice daily or more frequently as needed to control dust.

F. If effective dust control cannot be maintained under windy conditions, temporarily suspend excavating and grading operations.

G. Cover truck trailers or maintain at least 2 feet of freeboard (vertical distance between the top of the load and the top of the trailer) on trucks hauling dirt, sand, soil, or other loose materials outside of the Site.

H. Contractor shall be responsible for the cleanliness of all paved roadways at points of access used for completion of the Work. When there is visible track-out from an unpaved road onto a paved public road, install wheel washers where the vehicles exit and enter onto the paved roads, wash the undercarriage of trucks and any equipment leaving the Site on each trip, or sweep the paved street at the end of each shift or more frequently as necessary to maintain cleanliness with a Mobil Athey or similar water spray pick-up broom-type street sweeper.

I. If watering of unpaved roads is not sufficient to control dust, reduce vehicle speeds to 15 mph or less.

J. Pave or seal construction roads that have traffic volumes for sustained periods of time of more than 50 daily trips by construction equipment or 150 total daily trips for all vehicles, extending at least 100-feet onto the Site from the main road.

3.4 CONTROL OF SURFACE WATER

A. Control surface water in accordance with the Drawings, the requirements of the CDPHE Construction Stormwater and Construction Dewatering Discharge permits, grading, erosion and sediment control permits, and the Stormwater Management Plan.

B. Dewatering Sediment Control: Sediment shall be contained within the construction site and may not be discharged into drainages and/ or jurisdictional waters. Contained sediment should be disposed at a designated location away from the Site. Water from dewatering shall be filtered so that sediment plumes are not deposited into drainage ways or wetlands.

1. Contractor shall develop a dewatering plan and obtain CDPHE Construction Dewatering Discharge Permit and obtain approval from the City of Thornton Project Manager prior to the start of any dewatering Work on the Site. The plan shall indicate the methodology and equipment that will filter water and indicate where stored sediment will be disposed of offsite. The plan shall designate a person or persons who will monitor the sediment control program and order decreased dewatering, as necessary, to prevent transport of sediment off the site.

2. If any sediment is deposited into jurisdictional water or wetland the City of Thornton Project Manager shall be contacted immediately, and Work shall stop until the sediment leak is repaired.

3.5 RUBBISH CONTROL

A. Prepare a trash abatement program and submit it to the City of Thornton Project Manager for review and approval. The program shall include placing litter, trash, and garbage in scavenger-proof, re-sealable containers. Rubbish includes, but is not limited to, cigarettes, cigars, gum wrappers, tissue, cans, paper, and bags.

B. Keep the Site and other areas near it in a neat and clean condition, free from any accumulation of rubbish. Dispose of rubbish and waste materials of any nature occurring at the Site, and establish regular intervals of collection and disposal of such materials and wastes.

C. Construction refuse, including but not limited to broken parts, wrapping material, cords, cables, wire, rope, strapping, twine, buckets, metal or plastic containers, boxes, and welding rods, shall be removed from the Site each day or placed into scavenger-proof containers which are emptied when full or weekly, whichever comes first.

D. Keep haul roads free from dirt, rubbish, and unnecessary obstructions resulting from operations.

E. Dispose of rubbish and surplus materials offsite in accordance with local codes and

ordinances governing locations and methods of disposal, and in conformance with applicable safety laws, and to the particular requirements of Part 1926 of the OSHA Safety and Health Standards for Construction.

F. Clean up and properly dispose of any oil, fuel, and other equipment leaks at the time of occurrence. Service/maintenance vehicles shall carry a bucket and pads to absorb leaks and spills. Notify City of Thornton Project Manager of any spills or leaks at the time of occurrence.

3.6 SANITATION

A. Toilet Facilities: Fixed or portable chemical toilets shall be provided wherever needed for the use of employees. Toilets shall conform to the requirements of Part 1926 of the OSHA Standards for Construction.

B. Sanitary and Other Organic Wastes: Arrange for a service to weekly collect sanitary and organic wastes. Wastes and refuse from sanitary facilities provided by the Contractor or organic material wastes from any other source related to the Work shall be disposed of away from the Site in accordance with Laws and Regulations pertaining thereto.

3.7 CHEMICALS

A. Herbicides, pesticides, and Safe Drinking Water Act (SDWA) regulated compounds shall not be used unless prior approval is obtained. If herbicides are needed, submit a written request specifying the type of herbicide to be used to the City of Thornton Project Manager. The City will obtain any necessary written approval to use the herbicide from the U.S. Fish and Wildlife Service and the U.S. Environmental Protection Agency. The City of Thornton Project Manager will notify the Contractor if herbicide use is approved.

B. Filter any polymer or boring fluids utilized during construction activities so that they are not discharged from the Site. Dispose of polymers and boring fluids offsite in accordance with local codes and ordinances.

C. General Fire Prevention Provisions

1. Smoking: Smoking shall be prohibited in underground excavations and at or in the vicinity of hazardous operations or combustible/flammable materials. “No Smoking” signs shall be posted in these areas.

2. Refueling: Special care shall be taken to prevent fires when refueling equipment.

3. Oil Filters, Cartridges, and Oily Rags: Used and discarded oil filters, cartridges, and oil rags or waste shall be removed from the Site and disposed of properly.

4. Storage of Flammables: Glass jugs or bottles shall not be used as storage containers for flammable materials. Gasoline, oil, grease, and other highly flammable materials shall be stored in compliance with all applicable regulatory requirements, at a site where debris is cleared within a radius of 25 feet.

5. Welding. Welding shall be accomplished in service areas when possible. If welding at field locations is required, flammable materials shall be cleared for a distance of 15 feet around the area.

3.8 FIRE PREVENTION

A. The Work shall be connected with the Contractor's temporary water supply system and shall be protected against damage by fire.

B. Provide hose connections and hose, water casks, chemical equipment, or other sufficient means for fighting fires in the temporary structures and other portions of the Work conforming to the requirements of Subpart F of the OSHA Standards for Construction.

C. Designate and instruct responsible persons in the operation of fire apparatus so as to prevent or minimize the hazard of fire.

D. Fire Reporting: There shall be at least one readily available telephone service to the Site. Appropriate telephone numbers shall be conspicuously posted near each telephone. Instructions shall be issued to notify the proper authorities immediately in case of fire.

E. Access for Fire Fighting

1. Every building adjacent to the Work shall be accessible to fire department apparatus by way of access roadways.

2. Access roadways shall not be obstructed in any manner, including parked vehicles. “No Parking” signs or other appropriate notice, or both, prohibiting obstruction may be required.

3. Access for use of heavy firefighting equipment shall be provided to the Site at the start of the Contract and be maintained until completion.

F. General Fire Prevention Provisions

1. Smoking: Smoking shall be prohibited in underground excavations and at or in the vicinity of hazardous operations or combustible/flammable materials. “No Smoking” signs shall be posted in these areas.

2. Refueling: Special care shall be taken to prevent fires when refueling equipment.

3. Oil Filters, Cartridges, and Oily Rags: Used and discarded oil filters, cartridges, and oil rags or waste shall be removed from the Site and disposed of properly.

4. Storage of Flammables: Glass jugs or bottles shall not be used as storage containers for flammable materials. Gasoline, oil, grease, and other highly flammable materials shall be stored in compliance with all applicable regulatory requirements, and either in a separate building, or at a site where debris is cleared within a radius of 25 feet. Storage buildings or sites shall be a minimum distance of 50 feet from other structures. Storage buildings shall be adequately posted with highly visible signs to warn of the flammables and to prohibit smoking in or around the buildings.

5. Welding. Welding shall be accomplished in service areas when possible. If welding at field locations is required, flammable materials shall be cleared for a distance of 15 feet around the area.

3.9 AIR QUALITY

A. Maintain vehicles and equipment in proper tune.

B. Use Best Available Control Technology on construction equipment, including a timing retardation.

C. Use natural-gas powered construction equipment where possible.

D. Institute a Trip Reduction Plan and encourage employee carpooling.

3.9 NOISE

A. Noise limits on construction equipment shall comply with the noise limits of the local jurisdiction or land management agency. Construction equipment shall be equipped with manufacturer's standard noise control devices (i.e., mufflers, acoustical lagging, and/or engineered enclosures). Take special care not to throttle the engine excessively and keep engine speed as low as possible. The Contractor shall not leave equipment running or idling needlessly, especially near noise-sensitive land uses. Noise-sensitive land uses include schools, nursing homes, hospitals, hotels, quiet recreational areas such as campgrounds and hiking trails, and areas where active raptor nests have been identified.

B. Use newer equipment whenever possible, and inspect construction equipment at periodic intervals to ensure proper maintenance and the presence of noise control devices (i.e., mufflers and shrouding, etc.).

C. Heavy, noisier equipment shall not come closer than 100 feet to the property line of any noise sensitive land use for any length of time, and shall avoid coming closer than 200 feet if multiple pieces of equipment are operating simultaneously. If such cases are unavoidable, avoid throttling the engine excessively or leaving the equipment running needlessly. Heavy equipment will be operated in a manner to comply with the City's noise ordinance and vibration performance standard.

D. Locate stationary noisy equipment away from construction boundaries that are near noise-sensitive uses.

E. Concrete trucks shall perform initial mixing and other activities that require high-revving of the truck engine a minimum of 600 feet from noise-sensitive land uses. Engine revolutions per minute shall be kept as low as possible at closer distances.

F. Use electric hand tools instead of gas-powered, whenever possible.

G. If dewatering pumps and generators are required to be operated between the hours of 6 p.m. and 6 a.m. within 600 feet of a noise-sensitive land use, they shall be treated with acoustical noise control measures (e.g., mufflers, shrouding, and/or

enclosures) so as not to exceed 56 db(A) at 50 feet or other appropriate requirements of the local jurisdiction.

H. If requested by the City of Thornton Project Manager, install temporary noise barriers for construction activities, including staging areas that occur closer than 100 feet from noise-sensitive land uses. Noise barriers can be made of plywood, heavy vinyl curtain material, natural or temporary earth berms, or stockpiles of construction material.

3.10 TREE PRUNING AND PROTECTION

A. Where tree pruning is required, hire a certified arborist to perform any necessary pruning in accordance with International Society of Arboriculture (ISA) standards. Pruning for utility line clearance shall be done in accordance with ISA standards and any pruning guidelines adopted by the county of jurisdiction. Contractor shall notify the City of Thornton Project Manager of any needed pruning that has not been identified on the Drawings. Tree pruning shall not involve the removal or harassment of active bird nests. The pruning of any trees must be approved in advance by the City's Land Acquisition agent as well as the City of Thornton Project Manager to ensure that the land owner and/or jurisdiction of the tree has approved the plan for tree pruning. Tree pruning shall not be performed in spring or summer unless otherwise approved by the City of Thornton Project Manager.

- END OF SECTION -

SECTION 01 60 00 - PRODUCTS MATERIALS AND EQUIPMENT

PART 1 -- GENERAL

1.1 DEFINITIONS

A. The word “Products,” as used in the Contract Documents is defined to include purchased items for incorporation into Work, regardless of whether specifically purchased for the project or taken from Contractor’s stock of previously purchased products. The word “Materials,” is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, installed, or applied to Work. The word “Equipment,” is defined as products with operational parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, and other like items). Definitions in this paragraph are not intended to negate the meaning of other terms used in the Contract Documents, including “specialties,” “systems,” “structure,” “finishes,” “accessories,” “furnishings,” “special construction,” and similar terms, which are self-explanatory and have recognized meanings in the construction industry.

B. Neither “Products” nor “Materials” nor “Equipment” includes machinery and equipment used for preparation, fabrication, conveying, and installation of Work.

1.2 SELECTION

A. Source Limitations: To the greatest extent possible for each unit of Work, provide products, materials, and equipment of a single kind from a single source.

B. Compatibility of Options: Where more than one choice is available as options for Contractor's selection of a product, material, or equipment, select an option which is compatible with other products, materials, or equipment. Compatibility is a basic general requirement of product, material and equipment selections.

1.3 TRANSPORTATION AND DELIVERY

A. Transport products by methods designed to avoid damage and deliver in undamaged condition in manufacturer's unopened containers and packaging.

B. Provide equipment and personnel to handle products, materials and equipment, including those furnished by Owner, if any, by methods designed to prevent soiling and damage.

C. Provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.

D. Control delivery schedules to minimize long-term storage of products at the Site and overcrowding of construction spaces. In particular, Contractor shall coordinate to minimize holding or storage times for flammable, hazardous, easily damaged, or materials sensitive to deterioration, theft, and other sources of loss.

1.4 STORAGE AND PROTECTION

A. Store Work by methods and means that will prevent damage, deterioration, and loss including theft. Store products in accordance with manufacturer's written instructions and with seals and labels intact and legible. Store sensitive products in weather-tight climate-controlled enclosures; maintain temperature and humidity ranges within tolerances required by manufacturer's recommendations.

B. For exterior storage of fabricated products, store products on sloped supports above ground. Cover products subject to deterioration with impervious sheet covering and provide ventilation to avoid condensation.

C. Store loose granular materials on solid flat surfaces in a well-drained area; prevent mixing with foreign matter.

D. Storage shall be arranged to provide access for inspection.

1.5 MAINTENANCE OF PRODUCTS IN STORAGE

A. Periodically inspect stored products on a scheduled basis to assure products are undamaged and are maintained under required conditions. Maintain a log of inspections and make the log available to the City of Thornton Project Manager on request.

B. Surfaces of products exposed to the elements shall not be adversely affected and weathering of finishes shall not occur.

C. For mechanical and electrical equipment, furnish a copy of the manufacturer's service instructions with each item.

D. Service products on a regularly scheduled basis. Maintain and submit a log of services as a record document prior to final acceptance in accordance with the Contract Documents.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 77 00 - PROJECT CLOSEOUT

PART 1 -- GENERAL

1.1 FINAL CLEANUP

A. Remove from the vicinity of the completed Work and adjacent areas affected by the Work, all rubbish, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. Acceptance of the Work is conditional upon satisfactory final cleanup, which shall include, as a minimum:

1. Remove grease, dirt, dust, paint or plaster splatter, stains, labels, fingerprints, and other foreign materials from exposed surfaces.
2. Repair, patch, and touch up marred surfaces to specified finish and match adjacent surfaces.
3. Broom clean exterior paved driveways and parking areas.
4. Hose clean sidewalks, loading areas, and others contiguous with the Site.
5. Remove snow and ice from access to appurtenance structures.
6. Leave water courses, gutters, and ditches open and clean.

1.2 COMPLETION CRITERIA

A. **Substantial Completion:** Substantial completion is defined as; the Standley Lake Pipeline shall be shall be fully operational.

B. Before notifying Owner and Engineer that Substantial Completion has been achieved, Contractor must have:

1. Completed all requirements necessary for the safe, proper, and complete operation of the Work as intended.
2. Prepared a punch list of incomplete Work for submission with the request for issuance of a certificate of Substantial Completion.
3. Submitted and received acceptance of accurate record drawings for all Work completed to date.
4. Submitted and received acceptance of warranties, bonds, guarantees, and O&M Manuals.
5. Completed all required services for testing and, where required, commissioning.
6. Delivered all spare parts, maintenance stock items, and special tools.

C. **Final Completion:** Final completion is defined as; all project sites and Contractor access shall be restored to pre-construction conditions. This includes restoration of open space, pavement, sidewalk, curb and gutter, trails (gravel, concrete etc) trees etc.

D. Before notifying Owner and Engineer that Final Completion has been achieved, Contractor must have:

1. Completed all punch list items and satisfied City of Thornton Project Manager

and Owner that all deficiencies are corrected.

2. Submitted releases from agreements as specified herein.
3. Submitted waiver of claims as required in the General Conditions.
4. Demobilized and cleaned the Site.
5. Furnished new permanent cylinders and key blanks for all locks.
6. Submitted maintenance stock items; spare parts; special tools.
7. Submitted certificates of inspection and acceptance by local governing agencies having jurisdiction.
8. Submitted Final Application for Payment.

1.3 RELEASES FROM AGREEMENTS

A. Furnish Owner written releases from property owners or public agencies where side agreements or special easements have been made, or where Contractor's operations have not been kept within the Owner's construction right-of-way.

B. In the event Contractor is unable to secure written releases:

1. Inform Owner of the reasons.
2. Owner or its representatives will examine the Site, and Owner will direct Contractor to complete the Work that may be necessary to satisfy terms of the side agreement or special easement.
3. Should Contractor refuse to perform this Work, Owner reserves right to have it done by separate contract and deduct cost of same from Contract Price, or require Contractor to furnish a satisfactory bond in a sum to cover legal Claims for damages.
4. When Owner is satisfied that the Work has been completed in agreement with Contract Documents and terms of side agreement special easement, right is reserved to waive requirement for written release if: (1) Contractor's failure to obtain such statement is due to grantor's refusal to sign, and this refusal is not based upon any legitimate Claims that Contractor has failed to fulfill terms of side agreement or special easement, or (ii) Contractor is unable to contact or has had undue hardship in contacting grantor.

1.4 CORRECTION OF DEFECTS

A. Earth fill or backfill that settles below the required finish elevations will be considered defective Work and shall be repaired under the General Conditions Article 13.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 02 21 13 - SITE PREPARATION

PART 1 -- GENERAL

1.1 SCOPE OF WORK

A. This section specifies site preparation which consists of clearing, grubbing, topsoil stockpiling, demolition, removal and re-setting. This section also specifies the temporary and permanent construction easements and their use and restoration.

1.2 EXISTING CONDITIONS

A. The Contractor shall determine the actual condition of the site as it affects the work by means of a thorough on-site inspection prior to beginning the work.

B. Site preparation shall not damage structures, landscaping, or vegetation adjacent to the site. The Contractor shall repair or replace any damaged property at contractor's expense to the Owner's satisfaction.

PART 2 -- PRODUCTS

2.1 MATERIALS

A. Wound paint shall be approved asphaltum base paint prepared especially for tree surgery.

B. Onsite topsoil shall be free of refuse, stumps, large roots, rocks, brush, heavy clay, hard clods, toxic substances, or other material detrimental to its use on this project.

PART 3 -- EXECUTION

3.1 PERMANENT EASEMENTS

A. All permanent easements available for use during construction shall be as shown on the Drawings. All easement agreements shall be the full responsibility of the Owner. Easements shall provide for the construction of all proposed facilities, provide access to the construction site, and can also be used as temporary storage space for construction equipment, piping materials, pipe bedding and backfill material, traffic control items, and other construction facilities. Prevention of pollution of the easement site(s) and protection of vegetation shall be in accordance with the drawings and contract documents.

B. By the date of final completion, each permanent easement site shall be restored to its original condition. The site shall be cleared of all construction related materials and debris. The site shall then be restored to its original grade and condition. All permanent easements shall be fully restored in accordance with the drawings and contract documents.

3.2 CONSTRUCTION STAKING

A. The Contractor shall stake out the construction, establish temporary benchmarks, lines, levels, reference points, centerlines, and verify all dimensions in relation to connection with existing facilities. The Contractor shall be solely responsible for all errors in connection with this work. All construction staking shall be at the Contractor's expense.

B. Prior to commencement of the work, the Contractor shall report to the Engineer any inconsistencies in the control survey and proposed lines, levels, grades, dimensions, or locations shown on the Drawings.

3.3 TREE/SHRUB INVENTORY

A. Where trees, shrubs, and/or their root zones will be impacted by construction, notify the Owner to inventory impacts prior to clearing. Following the Owner/governing agency's inventory of impacts, commence with clearing operations.

B. Removal or trimming of trees shall be performed by the Owner/governing agency's arborist of choice and at the expense of the Contractor.

3.4 CLEARING AND GRUBBING

A. The Contractor shall install temporary fencing and silt fencing at all construction limits in accordance with the drawings and contract documents prior to commencing any clearing and grubbing activities.

B. The Contractor shall contact the Owner in accordance with this Section and other applicable drawings or specification sections to request that tree and shrub impacts be inventoried prior to clearing and grubbing.

C. Unless otherwise specified, the Contractor shall remove obstructions such as brush, trees, logs, stumps, roots, heavy sod, vegetation, rock, stones larger than 6 inches in any dimension, broken or old concrete and pavement, debris, and structures where the completion of the work requires their removal.

D. Material that is removed and is not to be incorporated in the work shall be disposed of by the Contractor at his expense.

E. No tree will be removed without the authorization of the Owner.

3.5 TOPSOIL

A. Strip as required to complete the Work.

B. Remove and replace upland topsoil to the pre-construction depth.

C. Topsoil shall be removed by a grader or front-end loader. Under no circumstances should topsoil be removed under moist soil moisture conditions. The subsoil should

be placed separate from the topsoil. Under no circumstances shall subsoil be mixed with or placed on top of topsoil. The topsoil shall be protected from contamination by subsoil material, weeds, or any other deleterious material, and from compaction by construction equipment and vehicles.

D. Stockpile topsoil.

1. Provide stockpile areas for topsoil. Topsoil stockpiles shall be suitably protected from erosion by wind and water.
2. Keep separate from other excavated materials.

3.6 DEMOLITION AND/OR REMOVAL AND RE-SETTING

A. Miscellaneous Small Structures

Demolition and/or removal and re-setting of miscellaneous small structures consists of mail boxes, traffic and road signs, telephone pedestals, utility marker posts, and any other small structures. Any necessary excavations caused by removal shall be cleared of waste, debris and loose soil, and refilled and compacted during the re-setting of the item. When structures are to be removed and later re-set in order to facilitate the completion of the work, due care shall be taken during the removal to prevent damage to the structure materials. All structures removed shall be re-set to a similar state as prior to construction.

B. Power Poles and Telephone Pedestals

Removal and re-location of power poles and telephone poles shall be coordinated with the proper utility or utilities. All coordination, permitting, and cost for the relocation of power poles and telephone pedestals shall be the responsibility of the Contractor. Re-location of power poles and telephone pedestals as called for on the Drawings should only be performed when no other viable option for construction of the new facilities is available or practical. All power poles and telephone pedestals shall be relocated by the governing utility.

C. Fences

Removal and re-setting of fences could consist of any type of fencing including steel post and wire, concrete, stone, wood post and board, wood post and rail, polyvinyl chloride or plastic, steel pipe, wood split rail, chain link, or wood panel fencing. When portions of fences are to be removed and later replaced in order to facilitate the completion of the work, due care shall be taken during the removal to prevent damage to the fencing materials. All fences removed shall be replaced to a similar state as prior to construction. All removal and replacement of fences shall be at the Contractor’s expense.

Removal and replacement of fences shall be coordinated with the specific property owner and may require the installation of temporary fencing in order to contain livestock in a safe manner. All temporary fencing construction will be at the Contractor’s expense.

D. Pavement

All streets, roads, drives, etc. shall be protected from damage by construction equipment and materials during the project. Any damage to the roadways due to construction activities shall be repaired or replaced by the Contractor at the Contractor's expense. When portions of asphalt or concrete pavements must be removed and replaced in order to facilitate the work, edges shall be saw cut, on a neat line at right angles. All pavement and concrete removal and replacement shall be per the standards and specifications of the local jurisdiction and these Specifications, as applicable, and shall be subject to inspection by jurisdiction personnel, as applicable. All asphalt and concrete pavement removed as part of the work shall be hauled from the site and properly disposed of at the Contractor's expense.

E. Drainage Culverts

1. Drainage culverts consist of piping that may be constructed of corrugated metal, reinforced concrete, PVC, cast iron, or other material that conveys solely storm sewer. Irrigation ditches are not drainage culverts.
2. Protect existing drainage culverts to prevent damage when temporarily removed in order to facilitate the completion of the work. Excavate, bed, backfill, compact, and reinstall existing drainage culverts to their original invert elevations and original or better conditions. Replace with new gaskets matching the original.

- END OF SECTION -

SECTION 02 42 00 - RESTORATION AND CLEAN-UP

PART 1 -- GENERAL

1.1 SCOPE OF WORK

A. This section specifies site restoration and clean-up which consists of construction and debris removal, site finishing, and road clean-up during construction.

1.2 EXISTING CONDITIONS

A. Existing site conditions shall be as determined in Section 02 21 13.

1.3 RELATED SECTIONS

A. Section 31 25 00 – Soil Surface Erosion Control. Section 01 14 00 - Construction Constraints. Section 01 50 10 – Protection of Existing Facilities. Section 01 57 19 – Temporary Environmental Controls.

PART 2 -- NOT USED

PART 3 – EXECUTION

3.1 SITE RESTORATION AND CLEAN-UP

A. At all times during the work, keep the construction areas clean and orderly, and upon completion of the work, repair all damage caused by equipment and leave the project site free of debris or excess material of any sort.

B. Stockpile excavated materials in a manner that will cause the least damage to adjacent grassed areas, irrigation systems, sidewalks, roadways, driveways, or fences regardless of whether these are on private property, or on project rights-of-way. Remove all excavated materials on a daily basis from asphalt, concrete, grassed and planted areas and leave these surfaces in a condition equivalent to their original condition.

C. All existing drainage ditches and culverts shall be reopened and the grade and natural drainage restored as soon as possible after disturbance. Restore culverts broken or damaged to their original condition and location.

D. Upon completion of the pipeline installation, re-grade, rake, and drag all disturbed areas, leaving them free from rocks, gravel, clay or any other foreign material and in their original condition. Remove all temporary structures, temporary fencing, rubbish, and waste materials. All disturbed areas shall be properly graded to blend in with the abutting undisturbed property. The finished surface shall be free-draining and free from holes, ruts, rough spots, or other detrimental surface features.

3.2 ROAD CLEAN-UP DURING CONSTRUCTION

A. All unpaved access roads (two-tracks) must be maintained throughout the duration of construction activities. This includes any grading, etc required to minimize rutting that occurs from vehicles and/or weather, either from Contractor inspection or Owner request.

B. Thoroughly clean all spilled dirt, gravel, or other foreign material on existing paved or gravel roadways caused by the construction operations at the conclusion of each day's operation.

3.3 TREE RESTORATION

A. Removal or trimming of trees shall be performed by the governing agency's arborist of choice at the Contractor's expense.

B. Replacement tree type, location, installation method, soil amendments and staking of replacement trees shall be as outlined by Owner's or governing agency's arborist. Owner or governing agency may request tree replacement to be performed by agency's arborist at the Contractor's expense.

- END OF SECTION -

02 90 00 - LANDSCAPE INSTALLATION

PART 1 -- GENERAL

1.1 DESCRIPTION OF WORK

A. The extent of landscaping work is shown on the Drawings and includes plant materials, grading, soil preparation, irrigation, fertilizing, and landscape work.

B. Related Work:

1. 02 10 00 Site Preparation
2. 02 81 00 Irrigation System
3. 31 23 19 Dewatering & Drainage
4. 31 25 00 Soil Surface Erosion Control
5. 31 23 00 Earthwork: Excavation & Fill

1.2 QUALITY ASSURANCE

A. Reference Standards:

1. U.S. Department of Agriculture Rules & Regulations under Federal Seed Act quality standards for Certified Seed.
2. ANSI Z60 1 requirements for measurements, grading, branching, quality, and the balling and burlapping of plants of the American Association of Nurserymen, Inc.
3. Plant measurements specified in the plant list are minimum acceptable sizes. Measure plants before pruning with branches in normal positions.

B. Quality of Materials:

1. Plant materials shall be available for inspection at their sources and at the site and may be rejected if, in the Project Manager's opinion, they fail to meet specified quality or appearance. Remove rejected material promptly from the site.
2. Plants shall have a habit of growth that is normal for the species. They shall be healthy, vigorous, and free from insect pests, plant diseases and injuries. All plant materials shall be inspected stock conforming to the State and Federal regulations.

1.3 SUBMITTALS

A. Approval of Submittals: Do not proceed with ordering, purchase or delivery of materials prior to receipt of approved submittals, substitutions & tests from Project Manager.

1. Required for all items specified herein. Provide five (5) copies of all product data sheets, cut sheets or test results and two (2) samples of all materials to the Project Manager for review.

2. Supply with cut sheets and samples a detailed list of materials proposed in this project, including Description, Manufacturer/Supplier, and Model.

3. Plant tags shall not be submitted but remain attached to the plants until Final Acceptance. After Final Acceptance Contractor shall remove all plant tags.

B. Substitutions:

1. Substitutions shall be made only with the written approval of the Project Manager. Substitutions will not be considered prior to opening of the bids.

2. Substitution of plant material will be made only on the basis of proof of unavailability.

3. Provide five (5) copies of a written request for substitution to the Project Manager for approval. Do not proceed with purchase or installation of materials prior to receipt of approved substitution from Project Manager. Include with the request proof of unavailability, product data, and supplier.

C. Testing: Contractor shall perform and submit the following tests to the Project Manager prior to proceeding with soil preparation or installation of plant material.

1. Submit soils test for imported topsoil and on site topsoil (stockpiled or unexcavated). Test shall include all macro and micronutrients, organic matter, and amendment recommendations from the testing laboratory. Each test shall be taken from at least three (3) sample locations, to provide an accurate cross section of the soils. The Project Manager may require additional testing if any significant discrepancy is shown by the tests.

2. Submit soils test for Organic Amendment. Test shall include all macro and micronutrients, salinity, organic matter, and carbon nitrogen ratio.

D. Record of Purchases: Package tags and receipts for all topsoil, soil amendments, fertilizers, mulch, fabric, seed, or sod shall be supplied to the Project Manager prior to installation.

1.4 PRODUCT DELIVERY, STORAGE & HANDLING

A. Delivery Schedule: Notify the Project Manager of delivery schedule not less than twenty four (24) working hours in advance of delivery of each type of material.

B. Package Materials: Deliver fertilizer to the site in unopened, original containers, each bearing the manufacturer's guaranteed analysis. Any fertilizer that becomes caked or otherwise damaged, making it unsuitable for use, will not be accepted.

C. Plant Materials: Containerize plant materials with limbs bound and properly wrapped and prepare them for shipping in accordance with recognized standard practice. Keep root systems moist and protected from adverse conditions due to climate and transportation between the time they are dug and actual planting.

1. Identify each plant with grower's label affixed to the plant. Use durable waterproof labels with water-resistant ink that will remain legible for at least sixty (60) days.

2. Plants to be transported to the project in open vehicles shall be covered with tarpaulins or other suitable covers securely fastened to the vehicle to prevent injury to the plants. Closed vehicles shall be adequately ventilated to prevent overheating of the plants. Do not remove plants from refrigerated trucks into hot weather without allowing time for plants to adjust to heat.

3. Plants shall be kept moist, fresh and protected at all times. Such protection shall encompass the entire period during which the plants are in transit, being handled, or are in temporary storage.

4. Plants shall not remain on the site of the work longer than three (3) days prior to planting. Deliver trees and shrubs after preparation for planting has been completed and plant immediately. If planting is delayed more than six (6) hours after delivery, set trees and shrubs in shade, protect from weather and mechanical damage, and keep roots moist by covering with mulch, burlap or other acceptable means of retaining moisture. Keep all roots moist before, during and after planting. Duration and method of storage are subject to the Project Manager's approval.

D. Handling: Do not drop plants. Do not lift plants by the trunk, stems, or foliage. Handle plants by the ball or the container. Reject balled plants if the ball is broken or the trunk is loose in the ball. Protect plants at all times from drying out or injury. Minor broken and damaged roots shall be pruned before planting. Major damage shall be cause for rejection as determined by the Project Manager.

1.5 JOB CONDITIONS

A. Contractor must examine the sub-grade, verify the elevations, and observe the conditions under which the work is to be performed, and notify the Project Manager of unsatisfactory conditions. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the City Project Manager.

B. Utilities: Determine location of underground utilities and perform work in a manner which will avoid possible damage. Do not permit heavy equipment such as trucks, rollers or bulldozers to damage utilities. Hand excavate, as required, to minimize the possibility of damage to underground utilities.

C. Any damage to underground piping or wiring arising out of work of this section must be corrected and repaired by the Contractor to the satisfaction of the Project Manager.

D. Damage to Other Improvements: All costs for repair or replacement of any damage to other work done on-site or adjacent properties by installation of plant material shall be borne by the Contractor installing plant material.

E. Existing grades, paving, vegetation and other improvements damaged during planting shall be restored at the Contractor's expense.

F. Install trees, shrubs, perennials, sod and seed after final grades are established unless otherwise acceptable to the Project Manager.

1.6 RIGHT OF REJECTION

A. The Project Manager reserves the right to reject at any time or place prior to Final Acceptance all plant materials, which in the Project Manager's opinion fail to meet specifications. Inspection of materials is primarily for quality, size and variety, but other requirements are not waived even though visual inspection results in approval. Plants may be inspected where available; however, inspection at the places of supply shall not preclude the right of rejection at the site or at a later time prior to Final Acceptance. Rejected materials shall be removed from the site within twenty-four (24) hours.

B. The Contractor shall schedule the inspection and tagging of plants by the Project Manager, at the supplier prior to delivery, to be completed in one visit. Any further inspection required due to plants being unavailable or rejected as not meeting specifications shall be charged to the Contractor at the current hourly rate (plus travel expenses if applicable) for Project Manager's personnel performing the inspection.

1.7 INSPECTION & ACCEPTANCE

A. In addition to informal, unscheduled inspections by city staff, the Landscape Contractor & General Contractor shall meet with the City Project Manager or his or her agent at the following inspection times. The City Construction Supervisor, Site, Landscape or Irrigation designer may be invited at the request of the Project Manager. Any material, product or workmanship deemed by the Project Manager to be unacceptable or not in accordance with these Drawings & Specifications shall be corrected immediately.

1. Pre-construction Conference.
2. Site Record: Prior to any site activity, Construction Manager shall record condition of all existing site features.
3. Protection of utilities, monuments, installations, site drainage, trees and plants to remain prior to any other site activity.
4. Sub-grade: Drainage, formwork and wall footer review (prior to placing cmu block, concrete or topsoil).
5. Materials: Prior to use (all mulch, compost and fertilizer immediately upon delivery to the site).
6. Plant selection prior to installation (all plants at one time, at nursery or site).
7. Tree location staking (prior to planting trees).
8. Irrigation main line installation completion (prior to trench backfill).
9. Finish grade.
10. Seed bed preparation, planting, drip, irrigation lateral line &, retaining wall cap (prior to seeding, fabric or mulch installation).
11. Seed & Sod installation, erosion control blanket and hydro or straw mulching completion. See Parks and Open Space Department Dedication and Development Criteria Manual, latest edition.

PART 2 -- PRODUCTS

2.1 SOIL ANALYSIS

A. When a soil analysis is required for horticultural purposes, the soil analysis shall be from a soil testing lab equipped to examine soil for horticultural use and make soil amendment recommendations specific to each horticultural use. Use Colorado Analytical Laboratory, (303-659-2313), or approved equal.

B. Soil samples shall be taken with a core sampler to a six (6) inch depth. One core sample shall be taken for each representative soil region of approximately ten thousand (10,000) square feet. Core samples shall be broken up in to small particles and mixed to create an average sample for a larger representative region. Specific soil regions shall be tested independently if there is any suspicion of substances that may inhibit the growth of plant material such as high salt concentration along roads or in basins so that this soil may be isolated and not used as top soil.

2.2 SITE TOPSOIL

A. See 31 23 00 Earthwork: Excavation & Fill.

B. The Project Manager reserves the right to inspect topsoil at its source to determine whether or not it meets the requirements specified and to approve the depth to which it may be stripped.

C. The Contractor shall supply any additional topsoil needed at no additional cost. See imported topsoil below.

2.3 IMPORTED TOPSOIL

A. See 31 23 00 Earthwork: Excavation & Fill for description of imported topsoil and storage of soil.

B. Contractor shall submit a one pound sample of imported topsoil and a current analysis of imported top soil.

C. The Project Manager reserves the right to inspect topsoil at its source to determine whether or not it meets the requirements specified and to approve the depth to which it may be stripped.

D. Amended topsoil purchased from a soil vendor and imported may be approved as equal to planter mix but must contain a minimum twenty-five percent (25%) organic material and soil that meets the specification for imported top soil.

E. Contractor shall submit a one pound sample of amended topsoil and a current analysis of the amended topsoil if imported to the site.

2.4 FERTILIZER

A. General: Fertilizer shall be delivered to the site, mixed as specified, in the original unopened standard size bags showing weight, analysis and name of manufacturer. Containers shall bear the manufacturer's guaranteed statement of analysis or a

manufacturer's certificate of compliance covering analysis. These shall be furnished to the Project Manager. Store fertilizer in a weatherproof place and in such a manner that it shall be kept dry and its effectiveness shall not be impaired.

B. Superphosphate: Soluble mixture of treated minerals, sixteen to twenty percent (16-20%) available phosphoric acid.

C. Commercial Fertilizer: Complete fertilizer containing the indicated percentages of available plant nutrients.

D. Granular: For, vines, flowers and groundcovers, provide a granular, slow release, commercial fertilizer with an analysis of 20-10-5.

E. Organic, slow release, low fertility fertilizer: Biosol Forte (7-2-1) or approved equal

2.5 ORGANIC SOIL AMENDMENT

A. Organic Material: Organic soil amendment shall be Approved, Certified Class II compost product meeting the requirements of this specification. Compost shall be produced on a site compliant with and in accordance with Colorado Department of Health and Environment (CDPHE) regulations pertaining to Solid Waste Composting, effective September 1, 2000. Vendors supplying compost shall supply written certification of compliance with these regulations including applicable permit numbers and facility classification information.

B. Compost shall be a totally organic product that has been aerobically and naturally processed without the addition of coarse wood chips, in such a manner as to maintain a consistent temperature of 140 degrees Fahrenheit or greater for a period of time sufficient to create the following characteristics, measured by dry weight.

Organic Matter: 25% - 30%
Carbon / nitrogen ratio -- less than 20:1
Salt Content: 8.0 mmhos/cm maximum
pH Range: 6.0 – 8.0
Less than 1% soil, dirt or sand
Maximum particle size of ½ inch diameter
Free of all harmful (i.e. noxious) weed seeds, pathogens and bacteria

C. Submit a one-(1) pound sample, verification of source and standard compost test results from an approved soils testing laboratory, 10 days prior to delivery.

2.6 MULCH

A. Submit only samples of mulches to be used as stated in the notes and plans.

1. Cedar Mulch: Double shredded long, thin fibers of bark & wood from Western Red Cedar. Submit sample.
2. River Rock: One and one-half inch (1½”) diameter washed rounded river rock; tan, gray or red; from a local source; Submit samples. Maximum 20% fractured piece

3. Local Cobble: Four to eight inch (4-8”) diameter washed rounded river rock; tan, gray or red; from a local source; Submit samples

4. White Cobble: Four to eight inch (4-8”) diameter washed rounded river rock; white in color; from a local source; Submit samples.

2.7 STAKING MATERIAL AND TREE WRAP

A. Tree Wrap: Shall be first quality, four-inch (4”) wide, bituminous impregnated tape, corrugated or crepe paper, brown in color, specifically manufactured for tree wrapping.

B. Secure tree wrap with a flexible nylon tape strapping specifically designed for tying plant material. No staples, string, cord, or other non-elastic material will be accepted.

C. Stakes: Shall be six-foot (6’) green steel “T” posts 1.33 Certified ASTM-A702 with blade, or thirty-inch (30”) steel “T” posts as determined by the notes, detail, or execution section of these specifications. From Hutchinson Western or Equal.

D. Fabric Tree Straps:

1. Trees shall be secured to stakes using minimum two-inch (2”) wide non-stretching webbing with grommets for attachment of wire between strap and stake. Strap shall be of sufficient length in relation to tree caliper so that grommets and wire do not touch trunk. (Foresight Industries PS-1, non-stretch tree collar straps, or approved substitution.)

2. Oversized fabric tree straps are required for evergreen trees taller than eight feet (8') and any tree that has a trunk too large for normal sized straps.

E. Wire: Shall be twelve (12) gauge galvanized steel wire. All wire shall be marked with flagging tape.

2.8 WEED BARRIER FABRIC

A. Weed barrier fabric shall be Mirascape Nonwoven Landscape Geosynthetic, earthtone color; available at Bowman Construction Supply – 303-696-8960 or approved equal. Submit sample and product data for approval.

2.9 EDGER

A. Edger to be steel unless otherwise noted on the plan.

B. Steel edger shall be four-inch (4”) depth, three-sixteenths inch (3/16”) thickness, interlocking steel edge, painted green with a rounded non cut top, staked with metal stakes sufficiently to hold in place; and installed per manufacturer’s recommendations. Use Pro Steel or approved equal.

2.10 PLANT MATERIALS

A. All Plants: Shall be the species subspecies or cultivar designated on the drawings. No substitutions will be accepted without prior written approval of the Project

Manager. All plants shall meet or exceed the code of the standards currently recommended by the “Colorado Nursery Act” and established by the American Association of Nurserymen as well as the ANSI Z60.1 "American Standard for Nursery Stock" latest version but upgraded to meet the following additional requirements.

1. Unless specifically noted otherwise, all plants shall be of selected specimen quality, exceptionally heavy, symmetrical, tightly knit, so trained or favored in their development and appearance as to be superior in form, number of branches, compactness and symmetry. All plants shall have a normal habit or sound, healthy, vigorous plants with well-developed root system.
2. Plants shall be free of disease, insect pests, eggs or larvae.
3. Plants shall not be pruned before delivery.
4. All plants shall have been grown under climatic conditions similar to those in the locality of the site of the project under construction or have been acclimated to such condition for at least two (2) years.
5. All plants designated balled and burlapped (B&B) must be moved with the root systems as solid units with balls of earth firmly wrapped with burlap pinned tight and secured with twine and a wire basket that has been tightened to the ball. The diameter and depth of the balls of earth must be sufficient to encompass the fibrous root feeding systems necessary for the healthy development of the plant and comply with ANSI Z60.1. No plant shall be accepted when the ball of earth surrounding its roots has been badly cracked or broken preparatory to or during the process of planting. All plants that cannot be planted at once must be heeled in by setting in the ground and covering the balls with soil or mulch and then watering. Burlap and twine made from hemp is preferable to synthetic fibers such as nylon.
6. Approximate Minimum ball size for trees are below. Check with American Standard Nursery Stock for exact specifications for each species (ANSI Z60.1).

TREE SIZE	BALL DEPTH MINIMUM	BALL DIAMETER MINIMUM
1 1/2" caliper	16"	20"
2" caliper	18"	22"
2 1/2" caliper	20"	24"
3" caliper	22"	28"

B. Deciduous Shade and Ornamental Trees

1. Provide B&B trees of sizes listed on the plan. Sizes indicate minimum height or caliper. All deciduous shade and ornamental trees shall have full, well–shaped crowns.
2. Trees with abrasion of the bark, sunscalds, disfiguring knots or fresh cuts of limbs over one inch (1") which have not completely calloused shall be rejected.
3. The trunk of each tree shall be a single trunk growing from a single unmutilated crown of roots, unless specified as "clump form".

C. Deciduous Shrubs

1. Provide shrubs of sizes listed on the plan. Sizes indicate minimum container size, height or spread as labeled. The size in spread shall be used for spreading shrubs and height for more upright types none shall have less than minimum number of canes required by ANSI Z60.1.
2. The thickness of each shrub shall correspond to the trade classification "No.1". Single stemmed or thin plants shall not be accepted. The side branches must be generous, well twigged, and the plant as a whole well branched to the ground. The plants must be in moist condition, free from dead wood, bruises or other root or branch injuries.

D. Evergreen Shrubs

1. Provide shrubs of sizes listed on the plan. Sizes indicate minimum container size, height or spread as labeled. The size in spread shall be used for spreading and semi-spreading type and height for other types, such as globe, dwarf, and cone, pyramidal, broad up right, and columnar.
2. The thickness of each shrub shall correspond to the trade classification "No.1". Single stemmed or thin plants shall not be accepted. The side branches must be generous, well twigged, and the plant as a whole well branched to the ground. The plants must be in moist condition, free from dead wood, bruises or other root or branch injuries.

E. Evergreen Trees

1. Provide evergreen trees of sizes listed on the plan. Sizes indicate minimum height. All evergreen trees shall be unsheared and full to the ground.
2. Provide balled and burlapped (B&B) or mechanical, spade-dug evergreen trees.

2.11 PRE-EMERGENT HERBICIDE

A. Shall be "Treflan" as manufactured by Elanco Company or approved substitution. Apply as per manufacturer's recommendations for weed control.

2.12 HYDROMULCH

A. See Parks and Open Space Department Dedication and Development Criteria Manual, latest edition.

2.13 WATER

A. The Owner shall provide onsite water for the execution and maintenance of landscape & irrigation to the Contractor at no expense.

B. The Contractor shall furnish all equipment necessary to distribute water from the source provided by the owner including but not limited to all pumps, valves, connections, nozzles, pipes, hose, irrigation equipment and portable tanks & vehicles necessary.

C. The Contractor shall comply with City of Thornton water use restrictions.

PART 3 -- EXECUTION

3.1 TOPSOIL PLACEMENT

A. Work Included: Place topsoil in sod or seed areas and to a minimum depth of six inches (6”) and in shrub beds or planters to a minimum depth of twelve inches (12”), unless noted otherwise on the plan or specified otherwise here within.

B. Area: All exterior ground within the limit of contract, except surfaces occupied by buildings and structures, paving, and except areas indicated to be undisturbed, shall have topsoil added.

C. Preparation: Rototill, disk, drag, harrow or hand rake sub-grade to a minimum depth of three inches (3") to provide bond for topsoil.

D. Placement of Topsoil: Place no topsoil until sub-grade has been approved. Before placing topsoil, rake subsoil surface clear of stones, debris, and roots. Compact topsoil to form a layer with minimum depth as defined in the notes. Topsoil shall be placed so that after final settlement there will be positive drainage and the surface will conform to the elevations shown on the drawings. Contractor is to maintain surfaces and place any additional topsoil necessary per Maintenance Specification.

E. Topsoil, which must be transported across finished walks, irrigation equipment, utilities or other improvements shall be delivered in such a manner that no damage will be done to the improvements. The Contractor shall be responsible for the repair of such damage.

3.2 FINISH AND FINE GRADING

A. Positive Surface Drainage: The Contractor shall finish and fine grade the project area to establish an even and well-matched grade over the entire surface. Positive surface drainage shall be assured, and there shall be no depressions, subsequent settling or irregularities in the finished grade.

B. Transitional Areas: At any transitional point or line where one plane intersects another, such as from a sloping area or berm to a level area, a smooth and gentle transition shall be made. There shall be no abrupt changes in grade which may appear unsightly or may cause mowing operations to damage the grasses, unless specifically noted otherwise. There shall also be a smooth transition between existing turf and new turf.

3.3 AMENDMENTS FOR SOIL PREPARATION

A. The schedule of soil amendments for various projects areas are listed below as a benchmark. The project specific amendment schedule shall be determined by the Project Manager after review of an analysis of site top soil from a soil testing lab equipped to examine soil for horticultural use. See soil analysis, site topsoil and imported top soil section above.

B. Site Bedding Mix: Shrub, Groundcover and Perennial Beds: Add not less than the following quantities of specified amendment materials to on-site top soil:

Organic Soil Amendment: 6 cubic yards per 1000 s.f.

Commercial Fertilizer (20-10-5): 10 lbs. per 1000 s.f.

Superphosphate @ 20% P2O5: 10 lbs. per 1,000 s.f.

C. Imported Bedding Mix: Shrub, Groundcover and Perennial Beds: Provide the following quantities of specified amendment materials to imported top soil:

Organic Soil Amendment: 5 cubic yards per 1000 s.f.

Commercial Fertilizer (20-10-5): 10 lbs. per 1000 s.f.

Superphosphate @ 20% P2O5: 10 lbs. per 1,000 s.f.

D. Planter Mix: Planters & tree preservation zones: Provide the following quantities of specified amendment material and mix thoroughly before placing soil in planter or root zone.

Top soil: Seventy five percent (75%) by volume, (Project Manager shall determine whether the Contractor shall use site top soil or imported top soil)

Organic Soil Amendment: Twenty-five percent (25%) by volume (not required if amended topsoil is imported)

Commercial Fertilizer (20-10-5): 10 lbs. per 1000 s.f.

Superphosphate @ 20% P2O5: 10 lbs. per 1,000 s.f.

E. Pit Mix: Backfill for lower portion of tree and shrub pits below the depth of any adjacent amended top soil shall be:

Imported Top Soil: ½ by volume.

Sub Soil Excavated From Tree Pit: ½ by volume.

OR

Organic Soil Amendment: ¼ by volume

Sub Soil Excavated From Tree Pit: ¾ by volume

3.4 SOIL PREPARATION

A. The Contractor shall complete finished grading of all landscaped areas.

B. Shrub, Groundcover and Annual/Perennial Beds: Spread specified amendment materials evenly over bed areas approximately two inches (2”) deep and thoroughly incorporate by rototilling or finely disking (max. 1” size), to a min. depth of six inches (6”). The areas shall then be compacted, fine graded and raked to meet the approved finished grade. The surface shall be smooth and loose and of fine texture.

C. Planters & Tree Preservation Zones: Areas that are contained by paving or walls that may or may not be raised above grade, areas adjacent to foundations, areas

that defined as tree protection zones in the tree protection specification and any area with existing woody plants to be preserved: Spread Planter Mix to a min. depth of nine inches (9”) unless specified otherwise on the plan, in the notes or in the detail. The areas shall then be settled, fine graded and raked to meet the approved finished grade. The surface shall be smooth and loose and of fine texture. Amended topsoil purchased from a soil vendor and imported may be approved as equal. If amended topsoil is imported, carefully and thoroughly mix the soil amendments by hand in the top six inches (6”) of soil.

D. Restore areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.

3.5 TREES AND SHRUB PLANTING OPERATIONS

A. Scheduling: Planting operations shall be performed at a steady rate of work unless weather conditions make it impossible to work. No plant material shall be planted in frozen ground.

B. Soil Conditions:

1. If rock or other underground obstruction is encountered, the Project Manager may require plant pits to be relocated, the pits enlarged or the plants deleted from the contract.

2. Plant Pit Drainage: In random tree/shrub holes (minimum 20%) throughout the site but in particular in plant pits near buildings, fill with water and let stand for twenty-four (24) hours. At the end of twenty-four (24) hours, check hole for drainage of water. Refill the holes and inspect again at twenty-four (24) hours. If the water has not percolated completely into soil, contact Project Manager for additional measures to insure proper drainage.

C. Delivery and Storage: Plants transported to the project in open vehicles shall be covered with tarpaulins or other suitable covers securely fastened to the body of the vehicle to prevent injury to the plants. Closed vehicles shall be adequately ventilated to prevent overheating of the plants. Evidence of inadequate protection following digging, carelessness while in transit, or improper handling or storage shall be cause for rejection. All plants shall be kept moist, fresh, and protected. Such protection shall encompass the entire period during which the plants are in transit, being handled, or are in temporary storage.

D. Planting

1. Planting Pits: Holes for balled and burlapped (B&B) trees and shrubs shall be at least two times the diameter of the root ball. Holes for shrubs, perennials, groundcovers and vines in pots shall be at least two times the diameter of the pot.

2. Plants shall be located in the center of the holes. Place root balls on undisturbed soil with a maximum of two inches (2”) of loose topsoil in the bottom of the hole to make sure all of the root system is in contact with soil and not air. Top of shrub root crown shall be zero to one inch (0-1”) above adjacent finish grade. Top of tree root flare shall be two to three inches (2”-3”) higher than

adjacent finish grade. Do not use any material to raise trees after they have been placed in the hole unless directed by the Project Manager. See details for additional information.

3. Root System: B&B plants shall be planted with root ball intact and undamaged. After being placed in the pit, all B&B plant material shall have the entire wire basket removed. Burlap shall be removed from the top two-thirds (2/3) of the root ball. Remove all twine from the root ball and the trunk. If the plant is in a plastic pot or a fiber pot larger than seven (7) gallons remove the pot after placing the plant in the pit. Container grown plants shall have root mass scored vertically on four sides prior to planting to encourage the roots to spread into the backfill soil. Root balls that are broken apart after containment is removed are damaged and shall be rejected. See details for additional information.
4. Backfill: Place specified amended backfill in maximum eight-inch (8") layers and then water each layer to settle the soil before the next layer is placed. Soil shall be lightly tamped under the edges of the plants and place enough soil to maintain finished grade after settling (no mechanical compaction will be allowed).
5. Mulch rings for trees in sod or seeded areas shall comply with requirements of details.
6. Temporary Watering Saucer: A watering saucer, ring or dam can be provided around each plant, but shall be removed and mulched per details prior to Substantial Completion.
7. Irrigation: Coordinate with irrigation sub-contractor in order to minimize future disturbance of backfill soil when subsurface drip irrigation is installed around trees.

E. Pruning: Prune trees and shrubs after planting in accordance with good horticultural practice. Prune trees and shrubs to retain required height, spread and natural character (do not cut tree leaders).

1. Remove only damaged or dead branches from shade & ornamental trees.
2. Remove and replace excessively pruned or misshaped stock resulting from improper pruning.

F. Guying/Staking and Wrapping:

1. Guy and stake trees immediately after planting, as shown on planting details. Eight-foot (8') foot stakes must be used on all shade trees as well as all evergreen & multi leader trees over eight feet (8') tall.
2. Wrap deciduous tree trunks per planting details between October 1st and November 1st. Before wrapping, notify the Project Manager and request an inspection of tree trunks for injury, improper pruning, and insect infestation. Landscape Contractor shall remove all wrappings between April 15th and May 1st.

3.6 WEED BARRIER FABRIC

A. The weed barrier fabric shall be placed over the soil in all planting areas mulched with rock or cobble. The mat shall be secured in place by sod pins per manufacturer's recommendations.

3.7 ORGANIC MULCH, BREEZE, GRAVEL, ROCK & COBBLE

A. Apply materials so that the top of their surface is level with adjacent finished grade as detailed and they are the minimum depth specified after settlement and compaction. Shredded bark mulch, local river & local cobble shall be used unless defined differently in the notes.

B. Specified shredded bark & cedar mulch shall be spread at a minimum three-inch (3") depth for trees in native grass seed areas; shrubs; spreading groundcovers and perennials, unless defined differently on the plan or in the notes. Mulch shall be placed up to the trunk of trees and up to the base of shrubs, groundcovers and perennials.

C. Specified gravel or river rock shall be spread at a minimum four-inch (4") depth for drainage ways, shrubs, ornamental grasses & trees in beds unless defined differently on the plan or in the notes.

D. Specified cobble shall be spread at a minimum eight-inch (8") depth. Hand select and place each cobble close together filling the larger voids with smaller cobble and leaving voids no greater than one inch (1"). Contractor shall prepare a one hundred (100) square feet minimum sample area for review by the Project Manager and the contractor shall make adjustments as may be requested by the Project Manager.

3.8 RESTORATION AND CLEANING

A. Restoration and Repair: Properly repair irrigation system components, underground pipe, electric wiring and other utilities damaged by this work.

B. Excess Materials and Debris: Remove pallets, unused sod, and other debris from the Project site. Clean paved areas over which operations have been conducted.

C. Empty containers, rocks, clods and other debris shall be removed daily and not allowed to accumulate throughout the entire operation of planting. The site shall be kept as tidy as possible at all times. Any soil, or similar material which has been brought onto paved areas by work operations, shall be removed promptly by sweeping and, if necessary, washing. Upon completion of the planting, all excess soils, rocks and debris which have not previously been cleaned up shall be removed from the site. All ground areas disturbed as a result of planting operations shall be restored to the desired finish grade.

3.9 WATERING

A. The Contractor is responsible for the distribution of water from the source provided by the owner. The contractor shall apply water in a manner consistent with these specifications and deemed appropriate by the Project Manager. The contractor shall be responsible for all watering necessary until final acceptance or full establishment

whichever is later. All areas of the site shall be watered in a manner to avoid excessive quantities in small areas, erosion or damage to adjacent finished surfaces and in compliance with City of Thornton watering restrictions or permit if applicable.

B. Trees, Shrubs, Ornamental Grasses, Groundcovers, Perennials and Annuals shall be watered twice within the first twenty-four hours after planting. Water shall be applied at low pressure to thoroughly soak the planting site without dislodging the soil.

C. The Contractor shall comply with City of Thornton water use restrictions.

- END OF SECTION -

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SECTION 03 31 00 – CAST-IN-PLACE CONCRETE, REINFORCEMENT, AND GROUT

PART 1 -- GENERAL

1.1 SCOPE OF WORK

A. This section specifies cast-in-place concrete and reinforcement for footings, slabs, floors, walls, piers, channels, pavements, pipe encasement, and structures.

B. Sidewalk, curb and gutter, and other similar concrete work shall conform to the requirements of the City of Thornton as identified in the City of Thornton Public Works Specifications Section 600 - Concrete Work.

1.2 QUALITY ASSURANCE

A. QUALITY CONTROL BY CONTRACTOR: To demonstrate conformance with the specified requirements for cast-in-place concrete, the Owner shall provide for testing which complies with the requirements of ASTM E329. Costs of testing laboratory services shall be paid by the Owner, except that any costs associated with re-testing or additional testing due to non-compliance with these specifications or any failed test shall be borne by the Contractor.

B. BASIS FOR QUALITY: Cast-in-place concrete shall conform to the requirements of ACI 301, except as modified. Unless specified otherwise, all formwork shall conform to ACI 347.

C. REFERENCES: This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ACI 211.1	Recommended Practice for Selecting Proportions for Normal and Heavy Weight Concrete
ACI 301	Specifications for Structural Concrete for Buildings
ACI 305R	Hot Weather Concreting
ACI 306R	Cold Weather Concreting
ACI 315	Details and Detailing of Concrete Reinforcement
ACI 347	Concrete Formwork
ASTM A185	Steel Welded Wire, Fabric, Plain for Concrete Reinforcement
ASTM A615	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A775	Epoxy-Coated Reinforcing Steel Bars
ASTM C31	Standard Method of Making and Curing Concrete Test Specimens in the Field
ASTM C33	Concrete Aggregates
ASTM C39	Standard Test for Compressive Strength of Cylindrical Concrete Specimens

ASTM C42	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C94	Ready-Mixed Concrete
ASTM C136	Sieve Analysis of Fine and Coarse Aggregates
ASTM C143	Standard Test for Slump of Portland Cement Concrete
ASTM C150	Portland Cement
ASTM C172	Sampling Fresh Concrete
ASTM C260	Air-Entraining Admixtures for Concrete
ASTM C309	Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494	Chemical Admixtures for Concrete
ASTM E329	Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction
CRSI-PRB	Placing Reinforcing Bars
CRSI-MSP 1	Manual of Standard Practice

1.3 SUBMITTALS

A. MIX DESIGN. Reports of concrete mix designs shall be provided in accordance with Section 01 33 00 and the City of Thornton's pre-approved materials list. Requirements for the reports are specified in paragraph 03 31 00-2.2D.

B. MANUFACTURER'S DATA. Copies of manufacturer's data shall be provided for the following:

1. Curing compounds

2. Bonding compounds

3. Admixtures

C. TEST REPORTS. Three copies of reports from the concrete supplier shall be provided certifying that all concrete materials comply with the specifications and all test requirements. All submitted test results and data are to be less than 12 months old.

D. READY-MIXED CONCRETE TRUCK DELIVERY TICKETS. Each load of ready-mixed concrete delivered to the job site shall be accompanied by a delivery ticket showing the information listed in ASTM C94, Section 16.

E. PLACING DRAWINGS. The Contractor shall prepare reinforcement placing drawings conforming to the requirements of ACI 315. Placing drawings shall include bar lists, schedules, bending details, placing details, and placing plans and elevations as required to fully delineate this portion of the work.

F. CERTIFIED MILL TEST REPORTS. The Contractor shall submit certified mill test reports for the reinforcement supplied.

PART 2 -- PRODUCTS

2.1 MATERIALS

A. CEMENT. Portland cement shall be ASTM C150, Type I-II, low alkali, containing less than 0.60 percent alkalies.

B. AGGREGATES

4. GENERAL: Fine and coarse aggregates shall conform to ASTM C33. Fine and coarse aggregates shall be tested in accordance with ASTM C136. Aggregates shall be non-reactive and shall be washed before use. When sources of aggregates are changed, test reports shall be provided for the new material. The tests specified shall be performed prior to commencing concrete work.

5. FINE AGGREGATE: Fine aggregate shall be hard, dense, durable particles of either sand or crushed stone regularly graded from coarse to fine. Gradation shall conform to ASTM C33.

6. COURSE AGGREGATE: Course aggregate shall be hard, dense and durable gravel or crushed rock free from injurious amounts of soft and friable particles, alkali, organic matter and other deleterious substances. Gradation of each coarse aggregate size specified in paragraph 03 31 00-2.2 B shall conform to ASTM C33-Table 2.

C. POZZOLAN: Pozzolan shall be Class C or F fly ash in accordance with ASTM C618.

D. ADMIXTURES

7. GENERAL: Admixtures shall be compatible with the concrete. Calcium chloride or admixtures containing calcium chloride are not acceptable. Admixtures shall be used in accordance with the manufacturer's recommendations and shall be added separately to the concrete mix.

8. WATER-REDUCING ADMIXTURES: Water-reducing admixtures shall be ASTM C494, Type A or D, and shall be Master Builders, Pozzolith or Polyheed; W. R. Grace and Co, WRDA Daracem 55; or equal.

9. AIR ENTRAINING AGENT: Air entraining agent shall be Master Builders, MB-AE10; W. R. Grace and Co., DaraVair; or equal. The air entraining agent added shall produce, in accordance with ASTM C260, an entrained air content specified in paragraph 03 31 00-2.2 B for each class of concrete.

E. WATER. Water for washing aggregate, for mixing and for curing shall be free from oil and deleterious amounts of acids, alkalies, and organic materials.

2.2 CONCRETE CHARACTERISTICS

A. MIX PROPORTIONING. Concrete shall be normal weight concrete composed of specified cement, admixtures, aggregates and water proportioned and mixed to produce a workable, strong, dense, and impermeable concrete.

B. Concrete shall be provided in accordance with the following:

Concrete class	ASTM coarse aggregate size	Minimum cement content, sacks/cu yd concrete	Pozzolan, Percent by weight of cement	Maximum water/ cement ratio by weight	Air content percent	Slump in inches	Minimum[a] 28-day compressive strength, psi
A	67	6.0	18-20	0.41	5±1	2-4[c]	5,000
B[b]	Size No. 8 ASSHTO M43	6.5	None	0.43	5±1	2-4	5,000
E	467	3.5	None	-	4±1	4-8	2,500

Notes for table:

[a] Compressive strength shall be determined at the end of 28 days based on test cylinders made and tested in accordance with ASTM D39.

[b] Concrete encasement for electrical conduit shall contain 3 pounds of red oxide dye per sack of cement.

[c] Slump may be increased to 6 inches with the use of an Engineer approved water-reducing admixture. The water/cement ratio shall not be increased.

C. CONTROL. Before beginning concrete work, the Contractor shall determine the proper proportions of materials for concrete. Methods for selecting and adjusting proportions of the ingredients shall be in accordance with ACI 211.1. Reports from the concrete supplier of each mix design shall state whether the items reported comply with the specifications and shall show (1) the expected strength, (2) corresponding slump, (3) weights and test results of the ingredients, and (4) other physical properties necessary to check each mix design. Copies of the reports shall be submitted in accordance with paragraph 03 31 00- 1.3C.

2.3 BONDING COMPOUNDS

A. Epoxy resin bonding compounds shall be used for wet areas and shall be Adhesive Engineering, Concresive Nos. 1001, 1001-LPL or 1180 as applicable; Sika Chemical Corporation, Sikadur 35, Hi-Mod LV, Sikadur 32, Hi-Mod, or Sikadur 31, Hi-Mod Gel as applicable; Burke Company 881 LPL Epoxy; or equal. Nonepoxy bonding compounds shall be used for dry areas and shall be Burke Company, Acrylic Bondcrete; Imperial Chemical Industrial, Inc., Thoro System Products, Acryl 60; Thorobond; or equal. Bonding compounds shall be applied in accordance with the manufacturer's instructions with the manufacturer's instructions.

2.4 CURING AND SEALING COMPOUNDS

A. Curing and sealing compound shall be Master Builders, Masterseal; A. C. Horn Inc., Horn Clearseal EM180; Burke Company Spartan-Cote WB Cure Seal Hardner; or equal;

conforming to ASTM C309. Curing compounds shall be clear and shall be applied in accordance with the manufacturer's instructions, except as otherwise specified.

2.5 BAR REINFORCEMENT

A. Reinforcing bars shall be deformed billet steel in conformance with ASTM A615, including supplementary requirements. Bars shall be Grade 60, except ties or field-bent bars where specified shall be Grade 40. Bars to be welded shall be deformed billet steel conforming to ASTM A706. ASTM A616 or ASTM A617 steel shall not be used. Bars provided as dowels for future construction and bars where specified shall be epoxy-coated in conformance with ASTM A775.

2.6 WIRE FABRIC

A. Wire fabric shall be welded steel mesh conforming to ASTM A185.

2.7 WIRE AND PLAIN BARS

A. Wire used as reinforcement and bars used as spiral reinforcement in structures shall be cold drawn steel conforming to ASTM A82.

2.8 TIE WIRE

A. The wire shall be minimum 16 gage annealed steel conforming to FEDSPEC QQ-W-461H.

2.9 BAR SUPPORTS

A. Bar supports coming into contact with forms shall be CRSI Class 1 plastic protected or Class 2 stainless steel protected and shall be located in accordance with CRSI MSP-1 and placed in accordance with CRSI PRB. Concrete block supports shall be provided for footing and slabs on grade. Stainless steel or plastic protected plain steel supports shall be provided for other work.

2.10 DRYPACK GROUT

A. Drypack grout shall be a mixture of approximately one part cement, 1-1/2 to 2 parts sand, water reducing admixture, and sufficient water to make a stiff workable mix.

2.11 NON-SHRINK GROUT

A. Non-shrink grout shall have non-metallic aggregate. Acceptable products are Sikagrout 212, by Sika Corporation, Five Star grout; or equal.

2.12 EPOXY GROUT FOR CRACK REPAIR AND DOWEL ANCHORAGE:

A. Except as noted below, epoxy grout shall be a high modulus, two-component, moisture insensitive, 100 percent solids, thermosetting modified polyamid epoxy compound. The consistency shall be a paste form capable of not sagging in horizontal or overhead anchoring configurations. Material shall conform to ASTM C881 Type 1, Grade 3, such as Adhesive Engineering Concresive 1440 series, Sika Corporation Sikadur Hi-Mod

Series, Adhesive Technology Corporation Solidbond 200 or equal, and shall have a heat deflection temperature in excess of 130 degrees F.

B. Epoxy for pressure grouting/crack injection shall be a two-component, moisture insensitive, high modulus, injection grade, 100 percent solids, blend of epoxy-resin compounds. The consistency shall be as required to achieve complete penetration in hairline cracks and larger. Material shall conform to ASTM C881 Type 1 Grade 1, such as Sika Corporation Sikadur 52, Adhesive Engineering Company SCB products, Adhesive Technology Corporation SLV 300 series, or equal.

2.13 POLYMER CONCRETE (FOR RESURFACING OR PATCHING):

A. Polymer concrete (for resurfacing or patching) shall consist of a liquid binder and dry aggregate mixed together to make a mortar or grout of a consistency as required for the application. The liquid binder shall be a chemical and oil resistant, stress relieved, low modulus, moisture insensitive, two-component epoxy-resin compound. The consistency shall be similar to lightweight oil for proper mixing with aggregate. Material shall conform to ASTM C881 Type 3 Grade 1, such as Sika Corporation Sikadur Lo-Mod series, Adhesive Engineering Concresive 1470, Adhesive Technology Corporation 400 series, or equal.

2.14 WATERSTOPS

A. Hydrophilic waterstops shall be Adeka MC-2010M Ultra Seal, and P-201 by Asahi Denka Kogyo K.K.; or approved equal.

B. Adhesive waterstops for construction joints abutting existing concrete shall be plastic adhesive waterstop as manufactured by Synko-Flex Products, Inc.

PART 3 -- EXECUTION

3.1 GENERAL

A. Construction of cast-in-place concrete shall be in accordance with the pertinent recommendations contained in ACI Manual of Concrete Practice, 300 Group and the following table.

Type of Use	Class of Concrete
Structural Concrete, Curb and Gutter	A or B
Thrust Blocks	E

3.2 FABRICATION OF REINFORCING

A. Reinforcing steel shall not be bent or straightened in a manner which will injure the material. Bars with kinks or with bends not shown shall not be used. Heating or welding bars shall only be permitted where specified or approved by the Engineer. Bars shall not be welded at the bend.

3.3 PLACEMENT OF REINFORCING

A. Reinforcing steel shall be placed in accordance with CRSI PRB and CRSI MSP-1.

B. Reinforcing steel shall be positioned accurately and secured against displacement by using annealed iron wire at intersections and shall be supported by concrete or metal chairs, spacers or metal hangers. Tack welding of cross bars is not acceptable. Bars shown on the drawings shall not be repositioned (buried) to act as support bars. Additional bars shall be provided as required for supports. Steel rods and pegs may be used to support reinforcing steel on rock foundations. Reinforcing steel shall be placed in such a manner as to not damage waterproofing membrane or plastic lining which has been previously applied or constructed. Reinforcing steel shall be shop-bent or slightly relocated where necessary to clear waterstop. Reinforcing steel shall not be placed on fresh concrete or forced into fresh concrete.

C. Supports for embedded items shall not be welded to the reinforcement. Additional reinforcement may be provided for this purpose.

3.4 SPLICING REINFORCING

A. Reinforcing steel shall be spliced as shown. Additional splices may be provided where approved by the Engineer.

B. In slabs, beams, girders and walls, reinforcing steel shall not be spliced in areas of maximum stress. Splices of adjacent bars shall be staggered at least one splice length, unless otherwise specified. Splices in welded wire fabric shall be at least 1 1/2 meshes wide.

3.5 CLEANING REINFORCING

A. Reinforcing steel shall be cleaned of mill rust scale, dried concrete, or other coatings that may reduce bond. Reinforcement reduced in section is not acceptable. When concrete placement is delayed, reinforcement shall be cleaned by sandblasting if directed by the Engineer.

3.6 CONCRETE

A. Concrete shall be truck-mixed, ready-mixed concrete conforming to the applicable portions of ASTM C94. Materials shall be proportioned by weighing. The Contractor shall be responsible for producing concrete of the specified characteristics.

B. Concrete shall be delivered to the site of work, and discharge shall be completed within 1-1/2 hours after introduction of the water to the mixture and before the concrete reaches 90 degrees F.

3.7 CONVEYING AND PLACING CONCRETE

A. CONVEYING CONCRETE. Concrete shall be conveyed from the mixer to the forms in accordance with ACI 301, Chapter 8. Concrete which has segregated in conveying shall be removed from the site of the work.

B. PLACING CONCRETE. Concrete shall be placed in accordance with ACI 301, Chapter 8, and ACI 304, Chapter 6. Pumped concrete shall be the class and consistency specified in paragraph 03 31 00-2.2.

10. PLACING CONCRETE IN HOT WEATHER: In hot weather (above 85 degrees F), concrete shall be placed in accordance with ACI 305R.

11. PLACING CONCRETE IN COLD WEATHER: In cold weather (below 45 degrees F), concrete shall be placed in accordance with ACI 306R.

3.8 CONCRETE FORMWORK

A. Formwork shall be installed in accordance with ACI 347.

3.9 CURING AND SEALING

A. GENERAL. Concrete curing shall be completed by water curing or by using a clear membrane curing compound or by a combination of both methods. Repairs or treatment of concrete surfaces shall be coordinated so that interruption of the curing will not be necessary.

B. Concrete surface temperature shall be maintained between 50 degrees F and 80 degrees F for at least 5 days. Curing concrete in hot weather (above 85 degrees F) shall be in accordance with ACI 305 R. Curing concrete in cold weather (below 45 degrees F) shall be in accordance with ACI 306 F.

C. WATER CURING. When water curing is used, concrete shall be kept wet continuously for a minimum of 10 days after placement. Absorptive mats or fabric may be used to retain moisture during the curing period.

D. CURING COMPOUND. When curing compound is used, it shall be applied as soon as the concrete has set sufficiently so as not to be marred by the application or immediately following form removal for vertical and other formed surfaces. Preparation of surfaces, quantities used, application procedures, and installation precautions shall be followed in strict compliance with the manufacturer's instructions.

E. Curing compound shall not be used on concrete surfaces to be coated, waterproofed, or moisture proofed.

3.10 PROTECTION

A. Concrete shall be protected from injurious action by sun, rain, flowing water, frost and mechanical injury.

3.11 CONSTRUCTION JOINTS

A. Construction joints shall be located and formed as shown on the plan or as approved by the Engineer.

B. Reinforcing steel and welded wire fabric shall be continued across construction joints. Waterstops shall be provided in construction joints at locations as specified.

3.12 EXPANSION JOINTS

A. Expansion joints shall be as specified. Reinforcement or other embedded metal items bonded to the concrete shall not extend through expansion joints. Waterstops shall be provided in expansion joints as shown on the plan and as specified in paragraph 03 31 00-2.14.

3.13 INSERTS AND EMBEDMENTS

A. INSERTS. Where pipes, castings or conduits are to pass through structures, the Contractor shall place such pipes or castings in the forms before placing the concrete, or he may provide openings in the concrete for subsequent insertion of such pipes, castings or conduits. Such openings shall be provided with waterstops and construction joint as shown and shall have a slight flare to facilitate grouting and permit the escape of entrained air during grouting.

B. Additional reinforcement shall be provided around large openings as shown.

C. EMBEDMENTS. Gate frames, gate thimbles, special castings, channels or other miscellaneous metal parts that are to be embedded in the concrete shall be set and secured in the forms prior to concrete placement. Unless otherwise specified, anchor bolts and inserts shall be embedded in concrete as shown. The Contractor shall provide inserts, anchors or other bolts necessary for the attachment of piping, valves, metal parts and equipment. Operators or sleeves for gate or valve stems shall be positioned to clear reinforcing steel, conduit and other embedments, and to align accurately with equipment.

3.14 MODIFICATION OF EXISTING CONCRETE

A. Existing concrete shall be removed and the remaining surfaces resurfaced as specified. The remaining concrete shall be protected from damage. Clean lines shall be made by sawing through the existing concrete. The concrete may be broken out after initial saw cuts in the event thickness prevents cutting through. Where it is not possible to use a saw, the initial cuts shall be made with chipping hammers. These cuts shall be sufficient to prevent damage to the remaining concrete. In general, an opening in existing concrete shall be oversized 1 inch on all sides and built back to the correct dimension with an epoxy grout. Where oversized openings cannot be made, the concrete shall be cut to the correct dimension, with the exposed reinforcing cut back an additional 1 inch and the resulting hole filled with epoxy grout. Cut or broken concrete surfaces shall be resurfaced with an epoxy grout. Concrete surfaces to be coated shall be dry. Where new concrete adjoins existing concrete surfaces or surfaces which have been cut, such surfaces shall be cleaned by sandblasting to remove laitance, loose coatings and foreign materials, and coated with the bonding compound just prior to the placement of the new concrete. Bonding compounds shall be as specified in paragraph 03 31 00-2.3. Unless otherwise specified, continuity of reinforcing steel shall be obtained across the joint either by exposing existing bars to provide sufficient laps with new bars or by welding existing bars with new bars. Dowels shall be drilled and set with epoxy grout into existing concrete.

3.15 FORMED SURFACE FINISHES

A. REPAIR OF SURFACE DEFECTS. Surface defects, including tie holes, minor honeycombing or otherwise defective concrete shall be repaired in accordance with ACI 301, Chapter 9. Areas to be patched shall be cleaned. Patches on exposed surfaces shall be finished to match the adjoining surfaces after they have set. Patches shall be cured as specified for the concrete.

B. FINISHING:

1. FINISH A: Finish A shall be a grout clean finish in accordance with ACI 301, Section 10.3.2. Surfaces shall be lightly sandblasted prior to sacking. For interior areas not exposed to moisture or weather, water used in the mortar shall be mixed with a PVA bonding compound as recommended by the manufacturer. Unless otherwise specified, Finish A shall be provided for all surfaces exposed to view, both painted and unpainted.

2. FINISH B: Finish B shall be the same as Finish A, except that the final burlap rubbing may be omitted, providing the steel trowel scraping removes the loose buildup from the surface. Finish B shall be provided for waterproof and moisture proof coated surfaces.

3. FINISH C: Finish C shall be a finish which has surface imperfections less than 3/8 inch in any dimension. Surface imperfections greater than 3/8 inch shall be repaired or removed and the affected areas neatly patched. Finish C or smoother shall be provided for interior surfaces of tanks and channels from 1 foot below minimum water surfaces and down and otherwise unfinished interior surfaces.

4. FINISH D: Unless otherwise specified, Finish D shall be the finish for surfaces not exposed to view in the finish work or by other construction, which may be left as they come from the forms, except that tie holes shall be plugged and defects greater than 1/2 inch in any dimension shall be repaired.

3.16 SLAB FINISHES

A. GENERAL. Where finish is not specified, floor slabs shall receive steel troweling. Dry cement shall not be used on new concrete surfaces to absorb excess moisture. Edges shall be rounded to a radius of 1/2 inch. Joints shall be grooved to a radius and depth of 1/4 inch each.

B. FLOAT FINISH. Float finish shall conform to ACI 301, Section 11.7.2. Floating shall be performed with a hand or power-driven float. Floating of any one area shall be the minimum necessary to produce the finish specified. Floating shall compact and smooth the surface and close any cracks and checking of surfaces. Float finish shall be applied to surfaces of channel and tank bottom slabs and to footings.

C. STEEL TROWEL FINISH. Steel trowel finish shall conform to ACI 301, Section 11.7.3. Immediately after final troweling, the surface shall be cured and protected as specified in paragraphs 03 31 00-3.9 and 03 31 00-3.10. Steel trowel finish shall be provided on floors unless specified otherwise.

D. BROOMED FINISH. Broomed finish shall conform to ACI 301, Section 11.7.4. Broomed finish shall be provided for walks, tops of walls, slabs on grade exposed to atmosphere, and where otherwise specified.

3.17 FIELD SAMPLING AND TESTING OF CONCRETE

A. GENERAL. Field sampling and testing shall be performed by the independent testing laboratory specified in paragraph 03 3100-1.2A. Samples of concrete shall be taken at random locations and at such times to represent the quality of the materials and work throughout the project. The laboratory shall provide the necessary labor, materials and facilities for sampling, casting, handling and storing the concrete samples at the site of work. The minimum number of samples and tests are specified in paragraph 03 31 00-3.17C.

B. SAMPLING. Concrete shall be sampled as follows and tested in accordance with paragraph 03 31 00-3.17 C. Samples of plastic concrete shall be obtained in accordance with ASTM C172. Samples for pumped concrete shall be taken at the hose discharge point. Samples for other concrete shall be taken at the hopper of transit mix truck.

C. TESTING

1. STRENGTH TESTS: The strengths specified for the design mix shall be verified by the testing laboratory during placement of the concrete. Verification shall be accomplished by testing standard cylinders of concrete samples taken at the job site.

2. Standard cylinders shall represent the concrete placed in the forms. One set of three standard cylinders shall be cast for each 50 cubic yards, or fraction thereof, for concrete placed in structures, building slabs and footings, but at least three cylinders shall be taken from any one batch. Casting, handling and curing of cylinders shall be in accordance with ASTM C31. Additional cylinders shall be provided when an error in batching is suspected. For the first 24 hours after casting, the cylinders shall be kept moist in a storage box constructed and located so that its interior air temperature will be between 60 and 80 degrees F. At the end of 24 hours, the cylinders shall be transported to the testing laboratory.

3. Testing of specimens for compressive strength shall be in accordance with ASTM C39. Tests shall be made at 7 and 28 days from time of casting. One test cylinder from each group of three shall be tested at the end of 7 days, and two shall be tested at the end of 28 days. Each strength test result shall be the average of the strengths of two test cylinders at 28 days, except that if one cylinder in a set of two shows evidence of low strength due to improper sampling, casting, handling or curing, the result of the remaining one cylinder shall be used.

4. The average of any three consecutive 28-day strength test results of the cylinders representing each class of concrete shall be equal to or greater than the specified strength and not more than 10 percent of the strength test results shall have values less than the specified 28-day strength for the total job concrete. No individual strength test results shall be less than the specified strength by more than 500 pounds per square inch.

5. Certified reports of the test results shall be provided directly to the Engineer. Test reports shall include sufficient information to identify the mix used, the stationing or location of the concrete placement, and the quantity placed. Slump and ambient temperature shall be noted.

6. If the 28-day test results fall below the specified compressive strength for the class of concrete required for any portion of the work, adjustment in the proportions, water content, or both, shall be made as necessary at the Contractor's expense. Changes and adjustments shall be reported in writing to the Engineer.

7. If compressive test results indicate concrete in place may not meet structural requirements, tests shall be made to determine if the structure or portion thereof is structurally sound. Tests may include, but not be limited to, cores in accordance with ASTM C42 and any other analyses or load tests acceptable to the Engineer. Costs of such tests shall be borne by the Contractor.

8. TESTS FOR CONSISTENCY OF CONCRETE: The slump shall be as specified when measured in accordance with ASTM C143. Samples for slump determination shall be taken from the concrete during placing. Slump tests shall be performed whenever standard cylinders are cast.

D. FINAL LABORATORY REPORT. A final report, prepared by the testing laboratory, shall be provided at the completion of all concreting. This report shall summarize the findings concerning concrete used in the project and provide totals of concrete used by class and structure.

3.18 CLEANUP

A. Upon completion of the work and prior to final inspection, the Contractor shall clean all concrete surfaces, except outside sidewalks or paved areas and those having curing and sealing compound.

- END OF SECTION -

SECTION 05 05 13.01 - SHOP-APPLIED COATINGS FOR METAL - ZINC

PART 1 -- GENERAL

1.1 DESCRIPTION

A. This section specifies hot-dip zinc coating.

1.2 SUBMITTALS

A. Provide the following product data information in accordance with Section 01 33 00 Submittal Procedures:

1. Zinc dust-zinc oxide coating manufacturer's product data showing conformance to the specified product.
2. Manufacturer's recommendation for application of zinc dust-zinc oxide coating.
3. Coating applicator's Certificate of Compliance that the hot-dip galvanized coating meets or exceeds the specified requirements of ASTM A123 or A153, as applicable.

1.3 REFERENCES

A. American Society of Testing and Materials (ASTM):

1.	ASTM A123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
2.	ASTM A143	Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
3.	ASTM A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
4.	ASTM A384	Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assembles
5.	ASTM A385	Providing High-Quality Zinc Coatings (Hot-Dip)
6.	ASTM A780	Repair of Damaged Hot-Dip Galvanized Coatings

B. Military Specification and Conformance Paints (MILSPEC):

1.	DOD-P-21035	Paint, High Zinc Dust Content, Galvanizing Repair

1.4 QUALITY ASSURANCE

A. Manufacturer shall be regularly engaged in the business specified herein for at least 5 years.

PART 2 -- PRODUCTS

2.1 MATERIALS

A. Zinc coating material as specified in ASTM A153.

B. Zinc dust-zinc oxide coating conforming to MILSPEC DOD-P-21035. Coating manufacturers: Z.R.C. Chemical Products Co., Galvicon Co., or approved equivalent.

2.2 FABRICATION REQUIREMENTS

A. In accordance with ASTM A143, A384 and A385 as applicable.

PART 3 -- EXECUTION

3.1 APPLICATION

A. Galvanize steel members, fabrications, and assemblies after fabrication in accordance with ASTM A123.

B. Unless otherwise specified, hot-dip zinc coat steel items weighing 100 pounds or less. Mechanically zinc coat anchor bolts and nuts 5/8 inch in diameter and other bolts, screws, nuts, washers, and other minor steel fasteners.

3.2 COATING REQUIREMENTS

A. Coating weight shall conform to paragraph 5.1 of ASTM A123 or Table 1 of ASTM A153 as applicable.

3.3 REPAIR OF DEFECTIVE GALVANIZED COATING

A. Where zinc coating has been damaged after installation, clean and repair substrate surface with zinc dust-zinc oxide coating in accordance with ASTM A780. Application shall be as recommended by the zinc dust-zinc oxide coating manufacturer. Coating shall consist of multiple coats to dry film thickness of 8 mils.

B. For items not physically damaged, but which have insufficient or deteriorating zinc coatings, and items damaged in shipment or prior to installation, remove and repair by the hot-dip zinc coating method at no additional cost to City of Thornton.

- END OF SECTION -

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 -- GENERAL

1.1 DESCRIPTION

A. This section specifies structural metals consisting of standard shapes, fasteners, rods and plates that are used in structural supports and connections.

1.2 QUALITY ASSURANCE

A. GENERAL

1. Structural assemblies and shop and field welding shall meet the requirements of the AISC AWS D1.1 Sec. 7 and AWS Code for Arc Welding in Building Construction Section 4, Workmanship

2. The use of salvaged, reprocessed, or scrap materials is not permitted.

1.3 REFERENCES

A. American Institution of Steel Construction (AISC):

1. Manual of Steel Construction, Allowable Stress Design, 9th Edition

B. American Society of Testing and Materials (ASTM):

1.	ASTM A36	Structural Steel
2.	ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
3.	ASTM A283	Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars
4.	ASTM A307	Carbon Steel Externally Threaded Standard Fasteners
5.	ASTM A320	Alloy-Steel Bolting Materials for Low Temperature Service
6.	ASTM A500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
7.	ASTM A666	Austenitic Stainless Steel, Sheet, Strip, Plate and Flat Bar for Structural Applications
8.	ASTM B308	Aluminum-Alloy Standard Structural Shapes, Rolled or Extruded

C. American Welding Society (AWS):

1.	AWS B3.0	Welding Procedures and Performance Qualifications
2.	AWS Dl.1	Structural Welding Code - Steel

1.4 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 00, Submittal Procedures.

B. Submit shop drawings showing materials, fabrication details, mark numbers,

connections, and dimensions. Drawings shall be adequate to represent manufacture, handling, and erection.

PART 2 -- PRODUCTS

2.1 MATERIALS

A. STEEL: Materials for structural metals shall be as follows:

1.	Standard rolled steel sections	ASTM A36
2.	Pipe columns	ASTM A53, Grade B
3.	Structural steel tubing	ASTM A500, Grade B
4.	Structural bars, plates and similar items	ASTM A36 or A283, Grade D
5.	Stainless steel	ASTM A666, Grade A, Type 304
6.	Stainless steel bolts, nuts and washers	ASTM A320, Type 304
7.	Steel bolts	ASTM A307, Grade A

B. ALUMINUM: Unless otherwise specified, extruded from 6061-T6 or 6063-T6 alloy, conforming to ASTM B308.

2.2 FABRICATION

A. In accordance with the AISC Manual of Steel Construction.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. GENERAL

1. Field verify measurements.
2. Punch holes 1/16 inch larger than the nominal size of the bolts, unless otherwise specified. Whenever needed, because of the thickness of the metal, subpunch holes and ream or drill. No drifting of bolts or enlargement of holes will be allowed to correct misalignment. Correct mismatched holes with new material.
3. Protect dissimilar metals from galvanic corrosion by means of pressure tapes, coatings or isolators. Protect aluminum in contact with concrete or grout with a heavy coat of bituminous paint.
4. Metalwork to be embedded in concrete shall be as specified in Section 03 30 00, Cast-in-Place Concrete. Place metalwork accurately and hold in correct position while the concrete is placed or, if specified, form recesses or blockouts in the concrete after design strength is attained. Grout metalwork in place in accordance with Section 03 30 00, Cast-in-Place Concrete. Thoroughly clean metalwork surfaces in contact with or embedded in concrete.
5. Do not galvanize or paint structural steel completely encased in concrete. Clean structural steel surfaces for bonding to concrete. Repair or replace metalwork that

is bent, broken or otherwise damaged, at no additional cost to City of Thornton.

B. WELDING

1. Unless otherwise specified, provide continuous welds on all structural members exposed to weather or submerged in water or wastewater. Provide continuous seal welds on both sides of plates or structural shapes in contact with or submerged in water or wastewater.

C. BOLTED CONNECTIONS: Conform to AISC Framed Beam Connections and bearing type connections with threads excluded from shear planes.

3.2 CORROSION PROTECTION

A. Unless otherwise specified, prepare surfaces and coat structural metal and structural steel, including that used in the fabrication of process equipment, in accordance with Section 09 90 04, Painting. Include the following operations:

1. Grind the exterior and interior edges of flame-cut plates or members to a smooth surface.

2. Grind sharp edges off of the sheared plates and punched holes.

3. Grind uneven or rough welds with high beads to a smooth finish.

B. Application requirements shall be as specified in Section 09 90 04, Painting.

C. Coat bolts, nuts, screws, and washers with mechanically applied zinc coating in accordance with ASTM B695. Coating thickness shall be Class 50.

3.3 CLEANING

A. After installation, clean and touch-up damaged surfaces of shop primed metals with the same material used for the shop coat. Repair damaged surfaces of galvanized metals as specified in Section 05 05 13.01, Shop-Applied Coatings for Metal - Zinc.

- END OF SECTION -

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 -- GENERAL

1.1 DESCRIPTION

A. This section specifies aluminum ladders, ladder safety post, and ladder safety access.

1.2 SUBMITTALS

A. Submit manufacturer's catalog and product data in accordance with Section 01 33 00, Submittal Procedures.

1.3 REFERENCES

A. American Institution of Steel Construction (AISC):

1. Manual of Steel Construction, Allowable Stress Design

B. American Society of Testing and Materials (ASTM):

1. ASTM A36 Structural Steel
2. ASTM A569 Steel, Sheet and Strip, Carbon, Hot Rolled, Commercial Quality
3. ASTM B210 Aluminum and Aluminum-Alloy Drawn Seamless Tubes
4. ASTM B221 Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
5. ASTM B308 Aluminum Alloy 6061-T6 Standard Structural Profiles
6. ASTM B241/B241M Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube

C. American National Standards Institute (ANSI):

1. ANSI A14.3 Safety Requirements for Fixed Ladders

D. Occupational Safety and Health Administration (OSHA), Code of Federal Regulations (CFR):

1. OSHA CFR 1910.27 Fixed Ladders

1.4 QUALITY ASSURANCE

A. Metal fabrications shall conform to the standards of the Occupational Safety and Health Administration (OSHA) and the International Building Code.

B. New materials of the best quality of their respective kinds.

C. Manufacturer shall be one who has been regularly engaged in the business specified herein for at least 5 years.

PART 2 -- PRODUCTS

2.1 LADDERS

A. Material: Aluminum, extruded from 6061-T6 or 6063-T6 alloy conforming to ASTM B308.

B. Fabricate ladders with rails, rungs, and landings to meeting applicable requirements of OSHA, CFR Part 1910.27, and ANSI A14.3.

1. Concentrated load of 250 pounds plus 30 percent impact on rungs.

2. Maximum rung deflection of 1/360.

3. Concentrated load of 250 pounds plus 30 percent impact between consecutive attachments.

2.2 LADDER SAFETY POST

A. Telescoping tubular, spring balanced and automatically locking in raised position with release lever for unlocking.

B. Bilco LadderUP Safety Post, Model LU-4, aluminum, mill finish. Equipped with channel clamping brackets and stainless steel bolts and washers. No substitutions accepted.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Drilling of bolts or enlargements of holes to correct misalignment is not allowed.

B. Protect dissimilar metal from galvanic corrosion by means of pressure tapes, coating or isolators. Protect aluminum in contact with concrete by a heavy coat of bituminous paint.

C. Place metalwork to be embedded in concrete accurately and hold in correct position while the concrete is placed or, if specified, form recesses or blockouts in the concrete and, after it has attained its design strength, grout the metalwork in place as specified in Section 03 30 00, Cast-in-Place Concrete. Thoroughly clean the surfaces of metalwork in contact with or embedded in concrete. If accepted, neatly core recesses in the concrete.

3.2 LADDERS/MANHOLE STEPS

A. Fit ladders accurately and field measure where necessary. Comply with applicable OSHA standards and International Building Code.

B. The first step shall be no more than 24” from ring and cover.

C. Top rung shall be located in the barrel section of the vault or manhole. Rungs/steps shall not be installed into grade rings.

3.3 LADDER SAFETY POSTS

A. Install safety posts in accordance with manufacturer’s instructions.

3.4 LADDER SAFETY ACCESS

A. Ensure that site is cleared to facilitate City of Thornton's ability to back up and access vaults, manholes, and pits with City of Thornton's standard work truck, with industrial equipment. This will allow City of Thornton's crew to use vehicle mounted air blowers for space ventilation and ladder safety fall protection devices. Notify City of Thornton if site clearance is not available.

3.5 CLEANING

A. After installation, clean and touch-up damaged surfaces of shop primed metals with the same material used for the shop coat. Repair damaged surfaces of galvanized metals as specified in Section 05 05 13.01, Shop-Applied Coatings for Metals - Zinc.

- END OF SECTION -

SECTION 09 90 04 - PAINTING

PART 1 -- GENERAL

1.1 DESCRIPTION

A. This section describes materials, methods and work for surface preparation, pretreatment, coating application, touch-up of factory-coated surfaces, protection of surfaces not to be coated, cleanup, and appurtenances.

B. Do not apply protective coatings to the following surfaces unless otherwise shown in the Drawings or specified herein or elsewhere in the Contract Documents.

1. Concrete
2. Stainless steel
3. Machined surfaces
4. Grease fittings
5. Manhole frames and covers
6. Equipment nameplates
7. Aluminum, except in contact with concrete
8. Galvanized steel

C. The coating system schedules summarize the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the Drawings are used to show exceptions to the schedules, to show or extend the limits of coating systems, or to clarify or show details for application of the coating systems.

1.2 REFERENCE STANDARDS

A. NACE - The published standards of National Association of Corrosion Engineers (NACE International), Houston, TX.

B. SSPC - The published standards of the Society of Protective Coatings, Pittsburgh, PA.

C. National Sanitation Foundations (NSF) Standard 61

D. American Water Works Association (AWWA)

1.3 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 00 Submittal Procedures.

B. Submit samples of paint, finishes, and other coating materials specified herein.

C. Submit a minimum of one 4” x 4” steel sample panel, for each Sandblast grade to be used on the project.

D. Provide coating materials list that indicates the manufacturer and coating number, keyed to the coating systems herein, prior to or at the time of submittal of samples.

E. Submit the following for each paint system to be used at least 30 days prior to painting.

1. Data sheet for each product used including statements on the suitability of the material for the intended use.
2. Instructions and recommendations on surface preparation and application.
3. Colors available for each product (where applicable).
4. Compatibility of shop and field applied coatings (where applicable).
5. Material Safety Data Sheet for each product used.
6. Two sets of color samples to match each color selected by the ENGINEER from the manufacturer's standard color sheets.

F. Submit manufacturer's certification for submerged and severe service coating systems certifying the following:

1. The manufacturer's representative has provided at least 6 hours of on-site instruction in the proper surface preparation, use, mixing, application, and curing of the coating systems.
2. The manufacturer's representative has personally observed the start of surface preparation, mixing, and application of the coating materials.

G. For shop-coated equipment, submit equipment manufacturer's certification that surface preparation and coatings are in conformance with these Specifications. Provide coating material data sheet.

H. Submit certificates within 7 days of completion of each paint system.

I. Provide the following minimum information for proposed substitutions. Include a minimum of 10 installations of similar service conditions that the proposed substitute product has shown satisfactory performance for at least several years. Include owner's contact name, address, and phone number of each installation.

1. Quality
2. Durability
3. Resistance to abrasion and physical damage
4. Life expectancy
5. Ability to recoat in future
6. Solids content by volume
7. Dry film thickness per coat
8. Compatibility with other coatings
9. Suitability for the intended service
10. Resistance to chemical attack

11. Temperature limitations in service and during application
12. Type and quality of recommended undercoats and topcoats
13. Ease of application
14. Ease of repairing damaged areas
15. Stability of colors

1.4 QUALITY ASSURANCE

A. Give the ENGINEER a minimum of 3 days advance notice of the start of field surface preparation work of coating application work and a minimum of 7 days advance notice of the start of shop surface preparation work.

B. Perform work in the presence of the ENGINEER, unless otherwise indicated.

C. Inspection by the ENGINEER, or the waiver of inspection of any particular portion of the Work, shall not relieve the CONTRACTOR's responsibility to perform the Work in accordance with these Specifications.

D. Where protective coatings are to be performed by a subcontractor, said subcontractor must possess a valid state license as required for performance of the painting and coating work called for in this specification and must provide 5 references which show that the painting subcontractor has previous successful experience with the specified or comparable coating systems. Include owner's name, address, and the telephone number of each installation for which the painting subcontractor had provided the protective coating.

E. Erect and locate scaffolding, in compliance with OSHA standards, where requested by the ENGINEER to facilitate inspection. Provide additional illumination to cover areas to be inspected.

F. Furnish, until final acceptance of such coatings, inspection devices in good working condition for the detection of holidays and measurement of dry-film thicknesses of protective coatings. Provide dry-film thickness gages for the ENGINEER's use while coating is being done, until final acceptance of such coatings. Operate holiday detection devices in the presence of the ENGINEER.

G. Holiday test coated ferrous surfaces that will be submerged in water or other liquids, or surfaces that are enclosed in a vapor space in such structures and surfaces coated with any of the submerged and severe service coating systems. Mark and repair or re-coat areas that contain holidays in accordance with the coating manufacturer's printed instructions and re-test.

1. Coatings with Thickness Exceeding 20 Mils: Test using a pulse-type holiday detector manufactured by Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20, or approved equivalent. Adjust the unit to operate at the required voltage to cause a spark jump across an air gap equal to twice the specified coating thickness.
2. Coatings with Thickness of 20 Mils or less: Test using a non-destructive type holiday detector manufactured by Tinker & Rasor Model M1, K-D Bird Dog, or approved equivalent. Operate the unit at less than 75-volts. For thicknesses

between 10 and 20 mils, add a non-sudsing type wetting agent, manufactured by Kodak Photo-Flo or approved equivalent, to the water prior to wetting the detector sponge.

H. On ferrous metals, measure the dry film coating thickness in accordance with the SSPC "Paint Application Specification No. 2" using a magnetic-type dry film thickness gage manufactured by Mikrotest Model FM, Elcometer Model 111/1EZ, or approved equivalent. Test each coat for the correct thickness. Do not take a measurement until at least 8 hours after coating application. On non-ferrous metals and other substrates, measure the coating thicknesses at the time of application using a wet film gage.

I. Evaluation of blast cleaned surface preparation work will be based upon comparison of the blasted surfaces per SSPC-SP5, SSPC-SP6, SSPC-SP7, and SSPC-SP10 as applicable.

1.5 MANUFACTURER'S REPRESENTATIVE

A. Furnish a qualified technical representative from the protective coating manufacturer to visit the project site for technical support as necessary to resolve field problems attributable or associated with the manufacturer's products.

1.6 MAINTENANCE

A. A warranty inspection may be conducted during the eleventh month following completion of coating and painting work. The CONTRACTOR and a representative of the coating material manufacturer shall attend this inspection. Repair defective work in accordance with these specifications and to the satisfaction of City of Thornton. City of Thornton may, by written notice to the CONTRACTOR, reschedule the warranty inspection to another date within the one-year correction period, or may cancel the warranty inspection altogether. If a warranty inspection is not held the CONTRACTOR is not relieved of its responsibilities under the Contract Documents.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Definitions: The term "paint", "coatings", or "finishes" as used herein, include surface treatments, emulsions, enamels, paints, epoxy resins, and other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat. The "DFT" means minimum dry film thickness.

B. General: Seal coating materials in containers that show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's directions, and name of manufacturer plainly legible at the time of use.

C. Use coating materials suitable for the intended use and recommended by the manufacturer for the intended service.

D. Provide paints, coatings, and finishes with no lead content.

E. Compatibility: In any coating system only compatible materials from a single manufacturer shall be used in the Work. Direct particular attention to compatibility of primers and finish coats. If necessary, subject to the approval of the ENGINEER, apply a barrier coat between existing prime coat and subsequent field coats to ensure compatibility.

F. Colors: City of Thornton will specify or select colors and shades of colors of paint from the manufacture's standard color samples. Each coat shall be of a slightly different shade to facilitate inspection of surface coverage of each coat.

G. Protective Coating Materials: Provide the names of not less than 10 successful applications of the proposed manufacturer's products demonstrating compliance with this specification.

2.2 INDUSTRIAL COATING SYSTEMS

A. Materials Sources: Each of the following manufacturers is capable of supplying many of the industrial coating materials specified herein. The manufacturers and paint numbers herein establish the minimum type and quality of coatings required.

1. Carboline Coatings Company
2. Devoe Coatings Company
3. Glidden Coatings and Resins
4. Pittsburgh Paints
5. Tnemec Company

2.3 COATING SYSTEMS

A. System Number 1 – Submerged Metal: NSF Epoxy; Polyamide epoxy approved for potable water service and conforming to NSF 61. 3 coats, 3 mils DFT per coat.

B. System Number 5 – Exposed Metal: Epoxy primer, 1 coat 2.5 mils DFT; Polyurethane Enamel, 1 coat 3 mils DFT.

C. System Number 27 – Aluminum and Dissimilar Metal Insulation: Bituminous paint, 1 coat 10 mils DFT.

PART 3 -- EXECUTION

3.1 STORAGE, MIXING, AND THINNING OF MATERIALS

A. Unless otherwise specified herein, adhere to the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for other procedures relative to coating.

B. Use protective coating materials within the manufacturer's recommended shelf life.

C. Protect coating materials from exposure to cold weather. Thoroughly stir, strain, and keep at a uniform consistency during application. Do not mix together coatings from different manufacturers.

3.2 PREPARATION FOR COATING

A. Clean surfaces to receive protective coatings prior to application of coatings. Examine surfaces to be coated and correct surface defects before application of coating material. Touch-up and restore marred or abraded spots on shop-primed and factory-finished surfaces prior to any coating application.

B. Protect surfaces not to be coated during surface preparation, cleaning, and coating operations.

C. Remove, mask, or protect hardware, lighting fixtures, switch plates, machined surfaces, couplings, shafts, bearing, nameplates on machinery, and other surfaces not to be painted. Provide drop cloths to prevent coating materials from falling on or marring adjacent surfaces. Protect the working parts of mechanical and electrical equipment from damage during surface preparation and coating operations. Mask openings in motors to prevent entry of coating or other materials.

D. Exercise care not to damage adjacent work during blast cleaning operations. Conduct spray painting under carefully controlled conditions. The CONTRACTOR is fully responsible for and shall promptly repair damage to adjacent work or adjoining property occurring from blast cleaning or coating operations.

E. Program cleaning and coating such that dust and other contaminants from the cleaning process will not fall on wet newly-coated surfaces.

3.3 SURFACE PREPARATION STANDARDS.

A. The following referenced surface preparation specifications of the Steel Structures Painting Council shall form a part of this specification.

1. Solvent Cleaning (SSPC-SP1): Removal of oil, grease, soil, salts, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.
2. Hand Tool Cleaning (SSPC-SP2): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter by hand chipping, scraping, sanding, and wire brushing.
3. Power Tool Cleaning (SSPC-SP3): Removal of rust, loose mill scale, loose paint, and other loose detrimental foreign matter by power tool chipping, descaling, sanding, wire brushing, and grinding.
4. White Metal Blast Cleaning (SSPC-SP5): Removal of visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products and foreign matter by blast cleaning.
5. Commercial Blast Cleaning (SSPC-SP6): Removal of visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.
6. Brush-Off Blast Cleaning (SSPC-SP7): Removal of visible oil, grease, soil, dust, loose mill scale, loose rust, and loose paint.
7. Near-White Blast Cleaning (SSPC-SP10): Removal of visible oil, grease, soil,

dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.

3.4 METAL SURFACE PREPARATION (UNGALVANIZED)

A. The minimum abrasive blasting surface preparation is specified in the coating system schedules included at the end of this Section. Where there is a conflict between these specifications and the coating manufacturer's recommendations for the intended service, the higher degree of cleaning shall apply.

B. Conform workmanship for metal surface preparation to current SSPC Standards and this Section.

C. Remove oil, grease, welding fluxes and other surface contaminants by solvent cleaning per SSPC-SP1 prior to blast cleaning.

D. Round or chamfer sharp edges and ground smooth burrs, surface defects, and weld splatter prior to blast cleaning.

E. Select the type and size of abrasive to produce a surface profile that meets the coating manufacturer's recommendation for the particular coating and service conditions. Abrasives for submerged and severe service coating systems shall be clean, hard, sharp cutting crushed slag.

F. Do not reuse abrasives unless otherwise approved by the ENGINEER. Maintain clean oil-free abrasives for automated shop blasting systems.

G. Comply with the applicable federal, state, and local air pollution control regulations for blast cleaning.

H. Supply compressed air for air blast cleaning at adequate pressure from well-maintained compressors equipped with oil/moisture separators that remove at least 95 percent of the contaminants.

I. Clean surfaces of dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming, or another approved method prior to painting.

J. Vacuum clean enclosed areas and other areas where dust settling is a problem and wipe with a tack cloth.

K. Remove damaged or defective coating by the specified blast cleaning to meet the clean surface requirements before recoating.

L. Use the SSPC-SP2, hand tool cleaning, or SSPC-SP3, power tool cleaning, if the specified abrasive blast cleaning will damage adjacent work, the area to be cleaned is less than 100 square feet, and the coated surface will not be submerged in service.

M. Remove shop applied coatings of unknown composition before the specified coatings are applied. Examine valves, castings, ductile or cast iron pipe, and fabricated pipe or equipment for the presence of shop-applied temporary coatings. Remove temporary coatings by solvent cleaning per SSPC-SP1 before starting the abrasive blast cleaning work.

N. Solvent clean shop primed equipment in the field before applying finish coats.

3.5 SURFACE PREPARATION OF FERROUS SURFACES WITH EXISTING COATINGS.

A. General: Remove grease, oil, heavy chalk, dirt, or other contaminants by solvent or detergent cleaning prior to abrasive blast cleaning. Determine the generic type of the existing coatings by laboratory testing.

B. Abrasive Blast Cleaning: Perform the degree of cleaning as specified in the coating system schedule for the entire surface to be coated. If the degree of cleaning is not specified in the schedule, remove deteriorated coatings by abrasive blast cleaning to SSPC-SP6. Clean areas of tightly adhering coatings per SSPC-SP7 with the remaining thickness of existing coating not to exceed 3 mils.

C. Incompatible Coatings: If coatings to be applied are not compatible with existing coatings, apply intermediate coatings per the paint manufacturer's recommendation for the specified coating system or remove the existing coating prior to abrasive blast cleaning. Conduct a small trial application for compatibility prior to painting large areas.

D. Unknown Coatings: Remove coatings of unknown composition prior to application of new coatings. Dispose of removed material in accordance with local, state, and federal regulations.

3.6 WORKMANSHIP

A. Use skilled craftsmen and experienced supervision on Work. Certify a minimum of 5 years practical experience in applying the types of coatings specified.

B. Use clean drop cloths. Clean, repair, and refinish damage to surfaces resulting from the Work to original or better condition.

C. Apply coatings under dry and dust-free conditions. Produce an even film of uniform thickness. Ensure edges, corners, crevices, and joints have been thoroughly cleaned and receive an adequate thickness of coating material. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. Complete the hiding so that the addition of another coat would not increase the hiding. Ensure that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas and protect installations by drop cloths or other approved precautionary measures.

3.7 SHOP COATING REQUIREMENTS

A. Unless otherwise indicated, shop-prime equipment items or parts of equipment not submerged in service and then finish coat in the field after installation with the specified or approved color. If the shop primer requires topcoating within a specified period of time, finish coat the equipment in the shop and then touch-up paint after installation.

B. Except pumps and valves, perform surface preparation and coating work in the field to equipment or parts and surfaces of equipment that are submerged or inside an

enclosed hydraulic structure when in service.

C. For certain pieces of equipment it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, equipment such as electrical control panels, switchgear or main control boards, submerged parts of pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the specified quality in the field. For such equipment, prime and finish coat in the shop and touch up in the field with the identical material after installation.

D. For certain small pieces of equipment the manufacturer may have a standard coating system that is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the Shop Drawings submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.

E. Protect shop painted surfaces during shipment and handle by suitable provisions including padding, blocking, and the use of canvas of nylon slings. Do not expose primed surfaces to weather for more than 2 months before topcoated or less time if recommended by the coating manufacturer.

F. Repair damage to shop-applied coatings in accordance with this Section and the coating manufacturer's instructions.

G. Ensure that shop primers and field topcoats are compatible and comply with these Specifications.

3.8 APPLICATION OF COATINGS

A. Apply protective coatings to steel substrates in accordance with SSPC-PA1.

B. Inspect cleaned surfaces and coats prior to each succeeding coat. Schedule such inspection with the ENGINEER in advance.

C. Paint blast cleaned ferrous metal surfaces before reusing or other deterioration of the surface occurs. Limit blast cleaning to only those surfaces that can be coated in the same working day.

D. Apply coatings in accordance with the manufacturer's instructions and recommendations, and this Specification, whichever has the most stringent requirements.

E. Ensure sufficient film thickness is applied to edges, angles, weld seams, flanges, nuts and bolts. Stripe paint these areas.

F. Ensure sufficient film thickness to materials that will be joined so closely that proper surface preparation and application are not possible. Coat such contact surfaces prior to assembly or installation.

G. Apply finish coats, including touch-up and damage repair coats, in a manner that will present a uniform texture and color matched appearance.

1. Abrasive blast clean and prime steel piping before installation.

2. Apply the finish coat on Work after concrete, masonry, and equipment installation is complete and the Work areas are clean and dust free.

H. Do not apply coatings under the following conditions:

1. Temperature exceeding the manufacturer's recommended maximum and minimum allowable.
2. Dust or smoke laden atmosphere.
3. Damp or humid weather.
4. When the substrate or air temperature is less than 5 degrees F above dewpoint.
5. When air temperature is expected to drop below 40 degrees F or less than 5 degrees F above the dewpoint within 8 hours after application of coating.
6. Determine dewpoint by use of a sling psychrometer in conjunction with U.S. Dept. of Commerce, Weather Bureau psychrometric tables.

3.9 CURING OF COATINGS

A. Provide curing conditions in accordance with the conditions recommended by the coating material manufacturer or by this Specification, whichever is the highest requirement, prior to placing the completed coating system into service.

B. In the case of enclosed areas, forced air ventilation, using heated air if necessary, may be required until the coatings have fully cured.

3.10 COATING SYSTEM SCHEDULES – FERROUS METALS

A. Coating System Schedule, Ferrous Metal:

Item	Surface Prep	System No
Ferrous surfaces in water passages, submerged surfaces, dismantling joints, interior face of blind flanges, and sleeve-couplings.	SSPC-SP5	1 - NSF Epoxy
Piping and miscellaneous metals in vaults, valve operators, air/vac valves, etc.	SSPC-SP10	5 - Epoxy primer/polyurethane enamel

B. Coating System Schedule, Non-Ferrous Metal:

Item	Surface Prep	System No
Aluminum in contact with concrete surfaces	SSPC-SP1	27 - Bituminous Paint

- END OF SECTION -

SECTION 09 90 05 - POLYURETHANE COATING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Work of this section includes the materials, installation, and testing of a polyurethane pipe coating system.

B. Except as described in this section, the coating system shall be in accordance with ANSI/AWWA C222 for straight pipe sections and fittings and ANSI/AWWA C216 for specials and field joints.

1.2 REFERENCES

A. Commercial Standards

1. AWWA C216, Heat-Shrinkable, Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
2. AWWA C217, Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines.
3. AWWA C222, Polyurethane Coatings for Interior and Exterior of Steel Water Pipe and Fittings.
4. AWWA C604, Installation of Steel Water Pipe 4-inches and Larger.
5. ASTM D4541, Standard Test Method for Pull Off Strength of Coatings Using Portable Adhesion Testers.
6. NACE SP-0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
7. Society for Protective Coatings (SSPC):
    a. SP-1, Solvent Cleaning Surface Preparation.
    b. SP-2, Hand Tool Cleaning Surface Preparation.
    c. SP-3, Power Tool Cleaning Surface Preparation.
    d. SP-6, Commercial Abrasive Blast Surface Preparation.
    e. SP-10, Near White Metal Abrasive Blast Surface Preparation.
    f. PA-2, Measurement of Dry Coating Thickness with Magnetic Gages

1.3 SUBMITTALS

A. Submit shop drawings in accordance with Specification Section 01 33 00, Submittal Procedures.

B. Action Submittals

1. Coating manufacturer certifications:
    a. Shop applied coating system applicator is an approved applicator.

b. Shop applied coating system applicator's equipment meets the requirements for material mixing, temperature control, application rate, and ratio control for multi-part coatings.

c. Shop applied coating system applicator's personnel are trained by the coating manufacture in the application and use of equipment for the coating material being applied. Identify the shop applied coating system applicator personnel certified by the coating manufacturer.

2. Certification of training from the heat shrink sleeve coating manufacturer or steel pipe manufacturer for exterior field coating of pipe joint applicators. Provide list of certified personnel proposed to be utilized on this project. Certification shall be effective within 12 months of starting the exterior field coating application.

3. Catalog cuts and other manufacturer's information for materials provided on a system-by-system basis.

4. Safety Data Sheet's (SDS), the manufacturer's technical data sheets, and paint colors available (where applicable) for each product used in coating system.

5. Technical and performance information that demonstrate coating system materials compliance with Specification.

6. Manufacturer's coating application quality assurance manual prior to beginning coating application.

7. Weld After Backfill Plan, including, at a minimum:

   a. Heat shrinkable sleeve manufacturer, model, and underlayment, if any.

   b. Special installation techniques required for this application, including, at a minimum:

      1) Low heat welding procedure, including welding process, welding materials, number of passes, voltage, amperage, travel speed, and calculated heat input.

      2) Method of measuring pipe wall temperature.

      3) Method of controlling heat flow through pipe joint gap.

   c. Written concurrence from heat shrinkable sleeve manufacturer of the Weld After Backfill Plan.

   d. Names of previously completed projects and contact information where this product(s) and method(s) have been successfully used for this type of application.

1.4 QUALITY ASSURANCE

A. Shop Applied Coating System Applicator's Experience and Certification: Coating applicator shall have not less than 5 years successful experience applying AWWA C22 polyurethane coating on AWWA C200 steel pipe and fittings. Coating applicator shall be certified by the coating manufacturer as an approved applicator. Coating applicator's personnel shall be trained in the coating material being applied by the

coating manufacturer. Shop equipment shall be certified by the coating manufacturer to meet the requirements for material mixing, temperature control, application rate, and ratio control for multi-part coatings. Equipment not meeting the coating manufacturer's written requirements will be rejected for coating application until repairs or replacement of the equipment is made to the satisfaction of the coating manufacturer and Engineer.

B. The coating manufacturer shall provide a qualified technical representative, employed by the coating manufacturer, at the shop applied coating facility for 1 day, minimum, at the start of coating application. During this visit, the manufacturer's representative shall conduct inspections as required to ensure that coating application is in conformance with their recommended methods and conditions.

C. Additional visits by the manufacturer's representative shall be made at sufficient intervals during surface preparation and coating application as may be required for product application quality assurance, and to determine compliance with manufacturer's instructions, and as may be necessary to resolve problems attributable to, or associated with, manufacturer's products furnished for this Project.

D. Heat Shrink Sleeve Field Coating Applicator's Certification or Experience: Heat shrink sleeve field coating applicators shall be certified and trained by the heat shrink sleeve coating manufacturer or steel pipe manufacturer, if the steel pipe manufacturer is qualified by the heat shrink sleeve coating manufacturer.

    1. Furnish heat shrink qualified technical representative on-site at beginning of field coating operations and as necessary to resolve field problems for technical support and to inspect that heat shrink installation is in accordance with manufacturer's recommendations.

    2. Furnish heat shrink qualified technical representative on-site at the demonstration of the Weld After Backfill procedure and as necessary to resolve field problems for technical support and to inspect that heat shrink installation is in accordance with manufacturer's recommendations.

E. Provide the Engineer a minimum of 7 days advance notice of the start of any shop coating work and a minimum of 3 days advance notice for field work.

F. Inspection Devices: Furnish inspection devices that are calibrated and in good working condition for the detection of holidays and measurement of coating film thickness.

G. Inspection: At a minimum, tests shall include holiday detection, adhesion testing, and coating film thickness. Perform adhesion testing on each pipe coated during the first full day of coating application and as requested by the Engineer if surface preparation or coating application is suspect.

H. Perform complete holiday detection of field coatings and repair defects.

I. Immediately before the coated pipe is lowered into the trench, provide a visual and field electrical holiday inspection of the pipe coating as specified in Paragraph 3.9.

J. Provide a log of visual and electric holiday inspections.

1.5 DELIVERY, HANDLING, AND STORAGE

A. Handle pipe in accordance with AWWA C222 and in such a manner as to protect the pipe and coating from damage.

B. Do not install coated pipe until the coating has developed full adhesion and cure.

C. Take precaution during coating application, storage, loading, transportation, unloading, laying and installation to protect and prevent damage to pipe and coating. Lift pipe in accordance with AWWA C604 and pipe manufacturer's instructions in a manner that will not damage the coating. Metal chains, cable, tongs, forklifts or other equipment likely to damage the coating will not be permitted. Dragging or skidding of pipe on grade or in the trench will not be permitted.

D. Provide transportation vehicles with padded bolsters between each layer of pipe and heavy padding under load ties. Bolsters shall be curved to fit the outside of the pipe and 12 inches wide, minimum. Heavily pad pipe contact locations with carpet during shipment to the Project Site and from the storage yard to the point of installation.

E. Do not store pipe on rocks, gravel, or other hard materials that might damage the coating. Provide padded 12 inch wide skids and chucks, sand bags, select loamy or sand berms, or suspended from cutback ends, where possible, to minimize coating damage. Do not lay pipe on asphalt without suitable padding at contact points.

F. Inspect pipe at the Project Site for damage. Repair damage to the pipe or coating as directed if, in the opinion of the Engineer, a satisfactory repair can be made; otherwise, replace the damaged section at the sole expense to the Contractor.

G. No metal tools or heavy objects shall be permitted to come into contact unnecessarily with the finished coating. Workmen shall not be permitted to walk on the coating except when absolutely necessary and approved by the Engineer. When permitted, use shoes with rubber or composition soles and heels or other suitable footwear that will not damage coating.

PART 2 - PRODUCTS

2.1 GENERAL

A. Store, handle, and apply coatings per the manufacturer's written directions. Clean and coat exterior pipe surfaces in accordance with referenced AWWA Standards, written directions of the coating manufacturer, and these Specifications, whichever is more stringent. Prepare other surfaces to be coated as required for steel pipe, as applicable.

B. Provide polyurethane coating from a single manufacturer. Substitutions will not be permitted.

2.2 EXTERIOR SHOP APPLIED COATINGS

A. Plural Component Polyurethane

1. Apply plural component polyurethane coating system (referred to hereafter as polyurethane system) in accordance with AWWA C222, except as modified herein.
2. Coating: Self-priming, plural component, 100 percent solids, polyurethane, suitable for burial or immersion, and the product of one of the following approved manufacturers:
    a. Madison Chemical Industries, Milton, Ontario
    b. LifeLast Incorporated, Vancouver, Washington
    c. Futura Coatings (Protec II), Hazelwood, Missouri
    d. Carboline Company, St. Louis, Missouri
    e. No substitutions.

B. Coating Thickness

1. Exterior Surface: Minimum 25 mil DFT
2. The polyurethane system may be applied to any maximum dry film thickness as recommended by the manufacturer. When applied at the maximum dry film thickness, the coating system shall pass all performance requirements as specified in AWWA C222.4.2.
3. Measure the dry film thickness of the coating in accordance with SSPC-PA 2. Delete the averages listed in SSPC-PA 2. No single gauge reading shall be less than the specified minimum thickness.

2.3 FIELD EXTERIOR JOINT COATING

A. Field coat pipe joints with heat shrink sleeves after pipe assembly in accordance with AWWA C216. Heat Shrinkable Sleeves:

1. Filler Tape: Extruded butyl rubber compound compatible with heat shrink sleeve. Polyken 939 or approved equivalent.
2. Heat Shrink Sleeve: Canusa Aqua-Shield. No substitutions accepted.
    a. Minimum Total Thickness: 90 mils.

B. Heat Shrinkable Sleeves for Weld After Backfill applications:

1. Minimum Total Thickness: 90 mils
2. Berry Plastics Corporation, Covalence WaterWrap 1.0/2.0 Heat Shrink Sleeves with Polyken 939 mastic filler, or approved equivalent.

2.4 FIELD REPAIR OF COATINGS

A. General

1. Field coating shall be compatible with the shop-applied coating system or shall be provided by the same manufacturer.

2. Apply coating to field joints using only personnel trained by the field coating manufacturer or steel pipe manufacturer.

B. Polyurethane Coating

1. Repair polyurethane coating system in accordance with the coating manufacturer's recommended procedures.

2. Coating material for repairs greater than 6 inches diameter shall be the same as the existing coating, or for repairs less than 6 inches diameter, repair coating as recommended by the polyurethane coating manufacturer, subject to Engineer approval. Repair coating shall have adhesion and performance characteristics equal to the existing coating.

2.5 FIELD COATING OF ACCESS MANWAYS, COUPLINGS, AND FLANGES

A. Field coat buried access manways and couplings with wax tape in accordance with AWWA C217. Apply manufacturer's filler to eliminate voids and provide smooth surfaces for tape.

B. Field coat flanges and blind flanges in accordance with Specification Section 09 90 04, Painting, System No. 100, or wax tape in accordance with AWWA C217. Apply manufacturer's filler to eliminate voids and provide smooth surface for tape.

PART 3 - EXECUTION

3.1 GENERAL

A. Inspect and provide substrate surfaces prepared in accordance with these Specifications and the printed directions and recommendations of coating manufacturer whose product is to be applied.

3.2 ENVIRONMENTAL CONTROLS

A. General

1. Provide heating, cooling, or dehumidification equipment as required to meet the surface preparation and coating application environmental requirements as specified and recommended by the coating manufacturer.

2. Products shall comply with federal, state, and local requirements limiting the emission of volatile organic compounds and worker exposure.

3. Comply with applicable federal, state, and local, air pollution and environmental control regulations for surface preparation, blast cleaning, disposition of spent aggregate and debris, and coating application.

4. Do not perform abrasive blast cleaning whenever the relative humidity exceeds 85 percent or whenever surface temperature is less than 5 degrees F above the dew point of the ambient air.

5. Do not apply coatings when:

a. Surface and ambient temperatures exceeds the maximum or minimum temperatures recommended by the paint manufacturer or these Specifications,

b. In dust or smoke laden atmosphere, blowing dust or debris, damp or humid weather, or under conditions that could cause icing on the metal surface.

6. Where weather conditions or Project requirements dictate, provide and operate heaters and/or dehumidification equipment to allow pipe surfaces be abrasive blasted and coated as specified and in accordance with the manufacturer's coating application recommendations.

B. Temperature Control

1. When temperatures are above or below the coating manufacturer's recommended application temperatures, provide temperature controls to permit Work to proceed within the temperature limitations of the Project.

2. Heat with indirect fired heaters that do not increase humidity levels within the Work area. Size heaters for the area to be heated.

3. Provide tenting, baffles, or bulkheads as required to zone and control the heating or cooling effectiveness.

3.3 SHOP APPLIED COATING SYSTEM

A. General

1. Strict conformance to the requirements of the manufacturer’s coating application manual will be required. Deviation from the requirements of the manual will be grounds for the Engineer to reject the applied coating. Remove rejected coating to bare metal and reapply using proper application methods in accordance with the quality assurance manual and the requirements of these Specifications.

2. Coating applied under improper environmental conditions will be rejected and removed to bare metal and reapplied under proper environmental conditions.

3. Pipes and other items that exceed the allowable quantity of coating defects, regardless of size or cause, shall be rejected and the coating removed to bare metal and recoated.

B. Surface Preparation

1. Remove visible oil, grease, dirt, and contamination in accordance with SSPC-SP1, solvent cleaning.

2. Remove surface imperfections such as metal slivers, burrs, weld splatter, gouges, or delaminations in the metal by filing or grinding prior to abrasive surface preparation.

3. In cold weather or when moisture collects on the pipe and the temperature of the pipe is less than 45 degrees F, preheat pipe to a temperature above 50 degrees F and 5 degrees F above dew point.

4. Clean pipe by abrasive blasting with a mixture of steel grit and shot to produce the surface preparation cleanliness as specified. Clean recycled abrasive of debris and spent abrasive.

5. Protect prepared pipe from humidity, moisture, and rain. Keep pipe clean, dry, and free of flash rust. Remove flash rust, imperfections, or contamination on cleaned pipe surface by reblasting prior to primer application.

6. Complete priming and coating of pipe the same day as surface preparation.

7. Surface Preparation: SSPC-SP10, Near White Metal blast, 3.0 mil profile, minimum, or as required by the manufacturer, whichever is greater.

C. Polyurethane Coating Application

1. Maintain pipe temperature between 75 and 100 degrees F and 5 degrees F above dew point during coating application. Perform coating application in an environmentally controlled area that meets or exceeds the written environmental application requirements of the coating manufacturer.

2. Thickness: Additional thickness may be required to pass the holiday and coating defects limitations as specified in this section.

3. Test coating adhesion and holiday testing as specified in this section.

4. Complete coating repairs as specified in this section.

D. Holdbacks and Cutbacks

1. 6 inches, minimum.

2. Make coating cutbacks or holdbacks straight and cut through the full thickness of the coating. Complete cutbacks in a manner that permits field coating of joints in accordance with the manufacturer’s recommendations and as specified herein.

3.4 FIELD COATING OF PIPE JOINTS - EXTERIOR

A. Coat exterior pipe joints with heat-shrinkable sleeves in accordance with AWWA C216 and as specified herein. Apply heat shrinkable sleeves to field joints using personnel trained by the heat shrink manufacturer or steel pipe manufacturer.

1. Prepare pipe surface as follows:

a. Adhere to OSHA and EPA regulations and coating manufacturer’s recommendations for surface preparation and coating application.

b. Power tool clean in accordance with SSPC-SP3 for shop blasted surfaces that have been coated with storage primer.

c. Hand tool clean areas to be coated in accordance with SSPC-SP2 that cannot be cleaned with power tool cleaning.

d. Solvent clean surfaces to be coated in accordance with SSPC-SP1.

e. Remove burrs, sharp edges, and weld spatter prior to abrasive blasting.

2. Apply filler tape at lap joints, step downs, and other discontinuities. Lap joints containing 1:1 sloped fillet welds do not require filler tape.

3. Fit coating material to area as recommended by manufacturer based on type and recovery of material.

4. Shrink the coating material to tightly conform to pipe joint and overlap shop coating using manufacturer's recommended heat sources and methods.

B. Completely remove and replace finish coatings having wrinkles, gaps, holes, or burns until acceptable coverage is achieved.

C. Coating application is prohibited when there is water or slurry in bell holes.

D. Holiday Testing

1. Clean and dry the pipe surface when tested.

2. To avoid damage to the coating, the electrode should always be kept in motion while test voltage is being applied. Always keep the electrode in firm contact with the coated surface. Move the electrode in an even manner over the surface at an approximate rate of 0.5 to 1 foot of travel per second. Do not exceed 1 foot of travel per second as the maximum rate of speed during holiday testing.

3. Mark location of detected holidays for repair. Retest after repair.

E. Comply with the special requirements of the Weld After Backfill Plan.

3.5 FIELD REPAIR OF COATING

A. General

1. Repair areas where holidays are detected or coating is visually damaged, such as blisters, tears, rips, bubbles, wrinkles, cuts, or other defects. Repair areas where no holidays are detected, but are visually damaged.

2. Clean area to be repaired for a minimum distance of 6 inches in all directions from the damaged area by solvent wiping.

B. Polyurethane Coating Repairs

1. Complete shop and field coating repairs in accordance with the manufacturer's written instructions and these Specifications, whichever is more stringent.

2. Unless otherwise accepted by Engineer, do not provide coating repairs on any joint of pipe greater than an average of 2 per 100 square feet of surface area per joint of pipe or an individual defect greater than 6 inches in diameter.

Holidays within a 4 inch radius of a holiday shall be counted as a single holiday.

3. Unless otherwise accepted by Engineer, blast pipes exceeding the maximum number or size of coating defects to bare metal and recoat.

4. Unless otherwise accepted by Engineer, pipe arriving in the field with defects or repairs exceeding the maximum number or size of coating defects will be returned to the shop for recoating at no additional cost to the Owner.

5. Repair surface defects, that do not expose the metal substrate by power tool sanding with coarse sandpaper to roughen the coating surface and feathering the edges of the defect for a minimum of 3 inches around the defect. Apply a single coat of the specified patch coating material to a properly prepared surface at the specified coating thickness.

6. Prepare deep defects, defined as defects which penetrate to the metal substrate or expose the metal substrate to the metal substrate by power tool sanding to expose the metal and feather the coating edges a minimum of 6 inches. Reblast the metal surface and surrounding coating to equal cleanliness and profile as the original surface preparation. Roughen existing coating to the equivalent of coarse sandpaper by abrasive blasting. Apply one coat of the specified coating material over the repaired surface at the specified thickness.

3.6 WAX TAPE COATING INSTALLATION

A. Coat bolts and nuts of all buried or exposed flanges, blind flanges, couplings, dismantling joints, etc. with three-part, cold-applied wax tape coating system consisting of primer, wax tape, and tape outerwrap.

B. Wax Tape Application

1. Ensure surfaces are free from loose rust, scale, paint, dirt, and other foreign matter in accordance with SSPC-SP2.

2. Apply primer by hand or brush to surfaces to be coated. Work primer into crevices, around studs and nuts, and completely cover exposed metal surfaces.

3. Extend primer a minimum of 3-inches onto adjacent surfaces of the pipe.

4. Apply wax tape immediately after primer application.

   a. Cut short lengths of tape and place around each bold head and nut.

   b. Work tape into crevices around studs and nuts.

   c. Cover entire primed area with wax tape using minimum overlap of 55% of tape width.

   d. Work tape into crevices and contours of irregular shaped surfaces and smooth out to obtain continuous protective layer with no voids or spaces under tape.

5. Apply tape outerwrap to wax tape installation. Extend plastic wrap a minimum of 3-inches beyond wax tape using a minimum overlap of 55% of plastic material width to apply two layers of overwrap.

3.7 SHOP QUALITY CONTROL

A. General

1. Owner may conduct additional quality assurance inspection and testing for final acceptance of the pipeline coatings. Coating repairs for quality assurance testing shall be repaired by the applicator as specified herein.

B. Adhesion Testing

1. General

a. In addition to the testing protocol required in AWWA C222, provide a minimum of four adhesion tests on four separate pipe joints for every production day.

b. Repair coating damage from adhesion testing.

c. Perform adhesion tests not less than 24 hours after coating application.

d. Pipe joints will be randomly selected for adhesion testing. If any one of the pipe joints tested fails the adhesion test, two additional tests shall be performed on that pipe joint. If any one of the additional tests fails, that pipe joint shall be rejected. An additional two pipe joints from that day's production shall be tested for every rejected pipe joint.

2. Polyurethane Adhesion Testing

a. Polyurethane coatings shall have an adhesion to steel of 1,500 pounds per square inch, minimum.

b. Test polyurethane coating adhesion to steel substrates using pneumatic pull off equipment, such as HATE equipment or equal, in accordance with ASTM D4541 and AWWA C222, except as modified in this section.

c. Glue dollies for adhesion testing to the coating surface and allow to cure for a minimum of 12 hours. Score coating around the dolly prior to conducting the adhesion test. Dollies shall be concave or convex to fit the pipe surface on any pipe less than 30 inches in diameter.

d. Failure shall be by adhesive failure only. Adhesive failure is defined as separation of the coating from the steel substrate on over 20 percent of the bonded surface. Glue failures in excess of the minimum required tensile adhesion are acceptable as meeting the specified adhesion requirements.

e. Randomly select repair patches on the polyurethane coating for adhesion testing in a manner as described herein and at the discretion of the person conducting the adhesion tests. Inter coat adhesion of

repairs shall be not less than 50 percent of the specified polyurethane coating adhesion requirements to steel.

3. Holiday Testing

   a. Polyurethane Coatings

      1) Conduct holiday tests on the completed coating after a minimum of 1 hour cure using a high voltage spark test in accordance with NACE Standard SP-0188 and these Specifications.

      2) Perform holiday testing at a voltage of 100 volts per mil of the average coating thickness.

      3) Use the average dry film thickness testing results to determine the coating thickness used for holiday testing.

   b. Dry Film Thickness Testing: Test coatings for dry film thickness in accordance with SSPC PA 2 using a properly calibrated magnetic pull off or eddy current equipment.

3.8 FIELD QUALITY CONTROL

A. Provide a visual and field electrical holiday inspection of the pipe coating immediately before the coated pipe is lowered into the trench.

B. Weld After Backfill Inspection and Testing

1. Prior to beginning pipe laying of each wall thickness, demonstrate the performance of the weld after backfill method.

2. Using test pipe of same thicknesses as project pipe, install the pipe, heat shrinkable sleeve, and weld the joint in accordance with these specifications and the Weld After Backfill Plan. Prior to welding, install bedding, pipe zone, and trench backfill in accordance with these specifications to simulate anticipated field conditions. Excavate joint and test, including destructive tests, the heat shrinkable sleeve to demonstrate compliance with AWWA C216. Specific testing to include:

   a. Visual inspection: No burns or excessive wrinkles.

   b. Holiday Test: Zero holidays.

   c. Adhesion: No areas of disbanded coating.

3. Perform successful demonstration test on each pipe wall thickness on the project.

4. East welder must successfully pass the above demonstration test.

5. Engineer will select production joints to be excavated and tested and may require destructive testing if visual or electrical holiday test indicates a compromised coating.

6. Upon completion of testing, repair joint coating and install specified pipe zone and trench zone backfill materials.

C. Electrical Coating Inspection

1. Electrically test field applied coatings and pipe coating repairs with a portable high-voltage holiday detector. Test areas as directed by the Engineer. Provide equipment and conduct testing in accordance with NACE Standard SP-0188 and the coating manufacturer's written directions for type and thickness of coating being tested. Furnish one portable high-voltage detector for each pipe laying crew.

2. Set electrical holiday test equipment at voltage as recommended by coating manufacturer. Set the minimum test voltage for a particular coating type and thickness to be within 20 percent of the voltage as determined by the following formula:

$$\text{Testing Voltage} = 1250\sqrt{T}$$

Where T = Average coating thickness in mils (0.001 inch)

3. Provide the type of detector with the minimum and maximum voltage setting, inspection speed, and holiday detector electrode type (wire brush or electrically conductive silicone or coil spring) as recommended by the coating manufacturer for the coating type and thickness being tested. Maintain the holiday test equipment in good working condition per detector manufacturer's recommendations.

4. Adjust the holiday detector during testing to the correct voltage setting and operate in accordance with holiday detector manufacturer recommendations. Recheck voltage setting at start of each day and a minimum of two times during the day and when requested by Engineer.

5. Provide the holiday detector with an audible signal when electrical contact is made between the pipeline and the electrode at holidays (defects) in the coating. Provide a good ground and a low electrical resistance between the holiday detector and the pipeline. Make only direct connections to uncoated areas or to the pipe ends at the pipe joint cut back areas.

6. Clean and dry the pipe surface when testing. To avoid damage to the coating, the electrode always be kept in motion while test voltage is being applied. Always keep the electrode in firm contact with the coated surface. Move the electrode in an even manner over the surface at an approximate rate of 0.5 to 1 foot of travel per second. Do not exceed 1 foot of travel per second as the maximum rate of speed during holiday testing.

7. Mark location of detected holidays for repair. Retest after repair.

- END OF SECTION -

SECTION 26 42 00 - CATHODIC PROTECTION

PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sacrificial anode cathodic protection and monitoring system for the protection of buried pipelines.
2. A third-party inspector will test all test wires to confirm pipe to soil reading. Contractor shall provide 24-hour notice. Contact City of Thornton Project Manager to schedule.

PART 2 -- REFERENCES

A. The latest revision of the following minimum standards shall apply to the materials and installation included in this Specification. In case of conflict, the most stringent requirements shall apply:

1. American Society for Testing and Materials (ASTM):
   a. A 153 – Zinc Coating (Hot Dip) on Iron and Steel Hardware.
   b. B843, Standard Specification for Magnesium Alloy Anodes for Cathodic Protection.
   c. D 1248, Class C, Grade 5 – Polyethylene Plastics Extrusion Materials for Wire and Cable.
   d. D 1785 Type 1, Grade 1 – Polyvinyl Chloride (PVC) Plastic Pipe.
2. National Association of Corrosion Engineer's International (NACE):
   a. Standard Practice SP0169 – Control of External Corrosion on Underground or Submerged Metallic Piping Systems.
   b. Standard Practice – SP0286 – Electrical Isolation of Cathodically Protected Pipelines.
3. National Electric Manufacturers Association (NEMA):
   a. Enclosures - Type 3, 3R, 3X, 4, and 4X.
   b. TC2 - Electrical Polyethylene Chloride (PVC) Conduit.
   c. TC3 - Polyvinyl Chloride (PVC) Fittings.
4. National Electrical Code (NEC).
5. Underwriters Laboratory (UL). (pertains only to electrical and not to Cathodic Protection)

2.2 DEFINITIONS

Cathodic Protection: the prevention of electrolytic corrosion of a metallic structure (such as a pipeline) by causing it to act as the cathode rather than as the anode of an electrochemical cell

A. Cathodic Protection Criteria: Conform to NACE SP0169.

B. Cathodic Protection Systems:

1. Galvanic anode system: Galvanic anode material, usually magnesium or zinc, which naturally corrodes or sacrifices itself and does not require an outside power source.
2. Impressed current system: Utilizes an outside power source, usually a rectifier (that converts AC to DC current), and forces (impresses) current from a number of anodes (or groundbed) through the environment to the structure to be protected.

C. Electrically Continuous Pipeline: means metallically connected as to be 1 continuous line

D. Electrical Isolation: The condition of being electrically isolated from other metallic structures and the environment as defined in NACE RP0286.

E. Ferrous or Metallic Pipe: Pipe or structure made of steel or iron alloys and pipe or structure containing steel or iron as a principal structural material (such as steel, ductile iron, and cast iron).

F. Foreign-Owned: Buried pipe or cable not specifically owned or operated by the Client.

G. Functional and Performance Testing:

1. Testing that is necessary to demonstrate that the installed equipment and systems function as specified and operate in the manner intended.
2. Functional testing is a prerequisite to performance testing for equipment and systems that are specified to have a performance test.

H. Structure-to-Reference Electrode Potential (also Structure-to-Reference Electrode Voltage): The difference in voltage (potential) between the subject metallic structure and the electrolyte in which it is buried or submerged, as measured to the standard specified reference electrode placed in contact with the electrolyte.

2.3 SYSTEM DESCRIPTION

A. Design Requirements: Materials and equipment shall be new and the manufacturer's latest standard design that complies with the specification requirements conforming to NACE standards.

B. Performance Requirements:

1. Show evidence of UL approval where UL standards exist and product listings are available.
2. Conform to the National Electrical Code (NEC) and applicable federal, state, and local laws, codes, and regulations.

2.4 SUBMITTALS

A. Submittals for Review:

1. Product data:
    a. Manufacturer's catalog cuts for all materials.
    b. Include manufacturer's name and provide sufficient information to show that materials meet the requirements of the Drawings and Specifications.
2. Quality Control:
    a. Sacrificial anode cathodic protection system and corrosion control monitoring systems including, but not limited to, joint bonding, test stations, and insulators are fully operational.
    b. CP Testing Plans and Procedures
        1) All CP testing plans and procedures shall be in accordance with the requirements herein and prepared by the CONTRACTOR's Cathodic Protection Specialist.
    c. Copies of field-collected data, including:
        1) Record drawings of installation and construction of CPS; accurate location and type of anodes, wires, conduits, insulators, pipe connections, and junction boxes.
        2) Field test reports.
        3) Contractor's Cathodic Protection Specialist qualifications.

2.5 QUALITY ASSURANCE

A. Contractor's Qualifications:

1. A minimum of 5 years of experience in the installation of sacrificial anode grounds beds and corrosion monitoring systems of comparable size and complexity as a part of their regular work.
2. Five comparable projects completed in the last 5 years for review and approval.

B. Cathodic Protection Specialist Qualifications:

1. Currently certified by NACE as a CP4 or Corrosion Specialist.
2. Perform field observation and oversee testing services during installation of cathodic protection system components associated with the project.
3. Verify proper installation of cathodic protection system components.

C. Manufacturer's Qualifications:

1. Regularly engaged on a full-time basis in the manufacture of products in this Section for a minimum of 5 years.
2. Provide certification that all materials and components meet the requirements of Drawings and Specifications; include references for the applicable section of the Specifications and applicable standard details.

D. Field Installation:

1. Currently certified by NACE as a CP1 or higher.

2. Minimum of 2 years of experience in corrosion control.

2.6 DELIVERY, STORAGE, AND HANDLING

A. Cathodic Protection Material:

1. Store off the ground.
2. Protect against weather, condensation, and mechanical damage.
3. Handle with care.
4. Do not sharply bend or tightly coil wires.
5. Replace equipment or materials damaged in shipment or installation.
6. Anodes:
   a. Coil anode wires and secure and package the anode in crates as required to prevent damage during shipping.
   b. Ensure that the wire is not damaged and that the anodes or lead connection are not physically stressed.

PART 3 -- PRODUCTS

3.1 MANUFACTURERS

A. Use of the manufacturer's name and model or catalog number is for the purpose of establishing a standard of quality and the general configuration desired.

B. Substitutions: As approved by ENGINEER if considered equal.

3.2 SUPPLIERS

A. Supplier: Farwest Corrosion Control, Denver, CO or MESA Products, Denver CO

B. Submit alternate suppliers for approval.

3.3 MATERIALS

A. Magnesium Anodes:

1. Composition: High potential magnesium, ASTM B843, Grade M1C.
2. Circuit Potential / Electrochemical Capacity: Open circuit potential of -1.50 volts or more negative in reference to a copper-copper sulfate reference electrode
3. Dimensions: For Ductile Iron Pipe / Fittings, use a high potential magnesium anode with a minimum bare weight of 48 lbs. and ingot length of 30 inches.
4. Anode Lead Wire Connection:
   a. Lead Wire:
      1) No. 12 AWG solid, copper conductor with THHN/THWN wire.
      2) Length: Sufficient to reach the test station terminal head without splicing additional wire. Recommend 50 foot leads.
   b. Anode Backfill Composition: 75% gypsum, 20% bentonite, and 5% sodium sulfate.

c. Thoroughly mix composition and package around anode within a cloth bag by means of adequate vibration.

B. Test Stations:

1. Flush-mount style:

a. Test station: Tyler 6860 Series valve box with phenolic terminal board, cast iron cover, stamped 'C.P. Test'.
b. Labels: Install Panduit label tags on all wires
1) List pipe diameter, pipe material, and wire function

C. Exothermic Welds:

1. All electrical cable connections to the buried piping or metallic fittings shall be made by an exothermic weld.

2. Exothermic type weld materials included the proper size and type of weld cartridges and welder molds for use on ductile iron or steel pipe shall be Erico Products Inc. CADWELD PLUS model or other approved equivalent.

3. Weld materials shall be compatible to the pipe material as recommended by the manufacturer.

4. Copper sleeves specifically designed for the purpose of exothermic welding shall be crimped on all bare wire ends prior to exothermic welding to improve mechanical strength and thermal capacity.

D. Di-Electric Coatings:

1. Pre-filled exothermic weld coatings shall consist of Royston Handy Cap IP or IPXL or approved equivalent.

2. All line pipes and pipe fittings shall be furnished with a factory applied coating as specified elsewhere herein. The factory applied coatings shall be inspected prior to installation and shall be installed in accordance with the manufacturer's recommendations.

3. All bare line pipe, uncoated flange bolts, uncoated mechanical fitting bolts, and other uncoated bolts, nuts, flanges, or fittings with metallic composition shall be protected with wax-tape primer and #1 wax-tape as manufactured by Trenton Corporation or approved equivalent and applied to a thickness of 20 mils.

E. Plastic Conduit for Cathodic Protection Sheathing for Lead Wires:

1. Diameter: Sized to match application.

2. Schedule 80 ASTM 1785 polyvinyl chloride (PVC) plastic pipe.

F. Wire:

1. Insulated stranded or solid copper wire as specified.

2. Wire size, type, and insulation type: As specified in this Section and as depicted on Drawings.

a. Joint Bonds: #2 AWG, Stranded, RHW/USE-2

b. Test leads: #12 AWG, solid RHW/USE-2
c. Anodes: #12 AWG, Solid, THHN/THWN

3. Wire insulation color: Indicate the function of each wire as shown on the Drawings.

a. Black: Project structure, anodes, or joint bonds
b. White: Non-project structure owned and operated by OWNER

G. In-Line Tap splices for Cathodic Protection Cables (use only if approved by ENGINEER):

1. "C" taps made of conductive wrought copper.

2. Sized to fit the wires being spliced.

3. Apply compression connectors the proper crimp tool and die recommended by the manufacturer for the wire and the tap connector size; in-line

4. "Butt" type wire splice connectors are acceptable for #10 AWG or smaller splices.

5. Electrical Splicing Tape and Coating:

a. Sources: Scotch 130C Polyvinyl Chloride tape, Scotch Super 88 tape, and Scotchkote Electrical Coating as manufactured by 3M Products.
b. 30 mil linerless rubber high voltage splicing tape and 7 mil vinyl electrical tape suitable for moist or wet environments and direct bury metallic connectors.

H. Wire Marker Tags: Manufactured of permanent weather resistant and UV light resistant nylon. Attached to a plastic non-releasing holding device and cable fastening tail. Marker tag writing surface: 0.75" long x 1.0" wide as manufactured by Panduit Corporation Part No. PLF1MA or approved equivalent.

I. CP Warning Tape: 3" plastic, APWA blue, non-detectable, marked "Caution Cathodic Protection Cable Buried Below"

J. Electrical Isolation Devices:

1. Electrical isolation of the buried waterline piping shall be accomplished by the use of insulating flange kits, insulating mechanical couplings, or a piece of non-metallic piping and fittings where specified herein or shown on the Drawings. In the event an insulating coupling is restrained using harness rods, each rod shall be insulated using a properly sized one-piece insulating sleeve and washer with steel backing washer.

2. Insulating flange kits shall be ordered according to pipe size and pressure rating of the flange and shall be installed per the manufacturer's instructions. Care shall be exercise so as not to damage the insulating bolt sleeves and washers.

3. Required applications of dielectric flange isolation assemblies, couplings, and other devices are not limited to selected locations where new piping is mechanically connected to existing piping. Other such examples include:

a. Transfer of ownership locations.

b. Connections between dissimilar metals (i.e. ductile main connection to copper water service line).
c. Cased segments of piping.
d. Connections to electrically grounded components such as actuated valves, pump stations, tank piping, and other facilities.
e. Concrete encased segments of piping such building risers and valve vault penetrations.

4. Materials:

a. Flange Insulating Gaskets
   1) For piping between 12 inches and 36 inches in diameter, provide G-10 epoxy glass gaskets with EPDM seal, Type 'E' full face gasket as manufactured by Pipeline Seal and Insulator, Inc. or approved equivalent.
b. Insulating Mechanical Couplings
   1) Approved manufacturers: Dresser "Style 39", Rockwell "416", Romac "IC501", Baker "Series 216" without pipe stop, or approved equivalent
c. Sleeves and Washers
   1) For piping between 12 inches and 36 inches in diameter, provide full length Mylar sleeves with G-10 washers as manufactured by Pipeline Seal and Insulator, Inc. or approved equivalent.
      a) For direct buried insulating kit applications, install single washer sets on the existing or uncathodically protected side of the insulating flange so that the metallic flange bolts, nuts, and washers are electrically continuous with the new or cathodically protected piping.
      b) For above grade or vaulted insulating kit applications, install double washer sets.
d. Coat all di-electric components to include nuts, bolts, and washers with wax-tape primer and #1 wax-tape as manufactured by Trenton Corporation or approved equivalent and applied to a thickness of 20 mils.

PART 4 -- EXECUTION

4.1 GENERAL

A. Complete anode placement, wire connections, joint bonding, installation of electrical isolation devices and backfill operations during daylight conditions.

B. Install corrosion protection system components, such as splices, bonds, and wire installation when ambient temperature is above 15°F and rising in order to minimize damage to materials and insulation.

C. Buried all cathodic protection wiring, conduits, and other components with a minimum of 3 feet of cover.

D. Do not Cadweld or utilize open flame or torches in areas of flammable vapors or airborne particles where a fire or explosion could result.

E. Install and work around above grade and buried AC power lines and oil and gas pipelines with extreme care; follow the minimum separation distances in accordance with foreign company requirements and regulations. CONTRACTOR is required to identify and notify all foreign owners of pending construction and schedule of when line crossings will occur.

F. Do not work next to power lines during times of high lightning activity.

4.2 INSTALLATION

A. Magnesium Anodes:

1. Install anodes as shown on Drawings.
2. Provide a minimum anode spacing of 3 feet from all buried metallic structures.
3. Install anodes equally along each side of pipeline spaced 5 feet on center. Anodes should be placed at or below the springline of the pipeline.
4. Route anode wires along excavation to test station. Bury wires a minimum of 24 inches below grade.
5. Thoroughly compact native backfill around each anode to a point 1 foot above anode.
6. Saturate the anode and backfill with approximately 5 gallons of clean water prior to completion of backfilling.
7. Install warning tape 12 inches above all anodes and anode wires.

B. Test Stations:

1. Determine location of test stations based on actual site conditions and as approved by ENGINEER.
2. Locate test stations as depicted on Drawings.
3. Attach test wires to pipe.
4. Locate all test stations behind curbs, outside of roadways, and in areas that are accessible for personnel.
    a. Provide OWNER's standard pipeline marker a minimum of 1 foot from test station for flush-mounted test stations.
5. Make wire connections to test station terminal boards with crimp-on spade lug terminals.
6. Wire labels and markings:
    a. Label and marking materials should be suitable for permanent identification.
    b. Position markers in boxes so that they do not interfere with operation and maintenance.
    c. Include pipe diameter and type, and wire function, as applicable.

C. Wire Connections:

1. Use thermite weld method for electrical connection of copper wire to metallic surfaces. Follow manufacturer's procedures for installation. Assure that the pipe or fitting wall thickness is of sufficient thickness that thermite weld process will not damage the integrity of the pipe or fitting or protective lining.
2. After cooling, remove all weld slag and visually inspect wire connection. Remove and replace any defective connections.
3. Install pre-fabricated thermite weld cap over each completed connection. Repair exposed metal surfaces not covered by thermite weld cap in accordance with coating manufacturer's recommendations.
4. Maintain a minimum of 12 inches of separation between any two wire connections.

D. Joint Bonding

1. All buried metallic pressure piping systems, which contain mechanical or non-metallurgical joints, shall be made electrically continuous by bonding with No. 2 AWG stranded copper wire. The bonding shall be achieved using the exothermic welding process with the number of bond wires required, per pipe joint, in accordance with the following:

Nominal Pipe Diameter	Wire Size	No. of Wires
<30"	#2 AWG	2
30" or greater	#2 AWG	3

E. Electrical Isolation

1. Accomplish electrical isolation using insulating flange kits or insulating mechanical couplings where shown on the Drawings. In the event an insulating coupling is restrained using harness rods, insulate each rod using a properly sized one-piece insulating sleeve and washer with steel backing washer.

4.3 FIELD QUALITY CONTROL

A. Preservation, restoration, and cleanup:

1. Keep the site neat and orderly at all times.
2. Remove excess equipment and materials when required by prevailing conditions.
3. Confine operations to construction easements and work areas.
4. Restore the site to a condition equivalent to the original condition to the satisfaction of the ENGINEER and the landowner.
5. Prevent contamination of project area:
   a. Do not dump or spill oil, fuel, solvents, coatings, rubbish, or similar materials on the ground or in or near streams or wetland areas.
   b. Use caution to prevent stream or groundwater contamination.
   c. Conform to federal, state, and local regulations.

6. Touch up scratches, scrapes, and chips in the interior and exterior surfaces of devices and equipment with finishes matching as nearly as possible the type, color, consistency, and type of surface of the original finish.
7. If extensive damage is done to equipment paint surfaces, completely refinish to equal or better than factory finish.
8. Repair damage to concrete and asphalt sidewalks, curbs, roads, and driveways.
9. If subsequent trench or undercrossing settlement, cracking, subsidence, or other indication of failure occurs within the warranty period, promptly repair or replace at the CONTRACTOR's sole expense.

B. Electrical Isolation Testing

1. Piping which is electrically isolated for corrosion control purposes shall be tested prior to and after backfilling to verify electrical isolation from unintended structures.
    a. CONTRACTOR's Cathodic Protection Specialist shall develop a test plan and submit to the ENGINEER and OWNER for approval prior to completing any testing.
    b. Acceptable test methods may include but not limited to:
        1) Induced current testing
        2) Flange Isolation Tester as per manufacturer's recommendations
        3) IR drop testing
        4) Remote 'Fixed Cell' testing
2. The pipeline shall be tested for electrical isolation at key elements to include but not limited to the following:
    a. Transfer of ownership locations.
    b. Connections between dissimilar metals (i.e. ductile main connection to copper water service line).
    c. Connections of old, existing metallic piping to newly installed metallic piping.
    d. Cased segments of piping.
    e. Connections to electrically grounded components such as actuated valves, pump stations, tank piping, and other facilities.
    f. Concrete encased segments of piping such building risers and valve vault penetrations.
3. Record Tests of each Electrical Isolation Component:
        1) Description and location of pipeline and electrical isolation component under test;
        2) Test method(s) utilized;
        3) Date of test;
        4) Summary of findings;
    b. The CONTRACTOR shall assist the ENGINEER in the performance of such additional tests by providing electrical contacts and physical access to the pipe. This work, and any subsequent repairs and additional testing shall be performed at no additional cost to the OWNER.

C. Joint Bond Electrical Continuity Testing

1. Piping which is electrically bonded for corrosion control purposes shall be tested prior to and after backfilling to verify electrical continuity.

2. Pressure piping requiring such testing shall be piping which has non-welded or mechanical joints, such as ductile iron or steel.

3. Testing Prior to Backfill (Digital Low Resistance Ohmmeter Test Method):

   a. General:
      1) The CONTRACTOR shall test completed joint bonds for electrical continuity using a digital low resistance ohmmeter (DLRO).
      2) Joint bond quality control test shall be performed on all bonded joints after the bonds are installed but before backfilling.
      3) Furnish all equipment and materials as required for test.

   b. Required Equipment and Materials:
      1) One Biddle Model 247001 or DLRO10HD (or equal).
      2) One set of duplex helical current and potential handspikes, Biddle Model No.242011 or similar, cable length as required.

   c. Test Procedure:
      1) Measure the resistance of joint bonds with the low resistance ohmmeter in accordance with the manufacturer's written instructions.
      2) Use the helical handspikes to contact the pipe on each side of the joint without touching the thermite weld or the bond. The contact area shall be cleaned to bright metal by filing or grinding and without any surface rusting or oxidation.
      3) Record the measured joint bond resistance on the test form described herein.
      4) Repair any damaged pipe coating in accordance with these specifications.

   d. Joint Bond Acceptance
      1) Joint bond resistance shall be less than or equal to the maximum allowable bond resistance values shown below.

Joint Bond Wire Size	Joint Bond Wire Length	Maximum Allowable Resistance (µ-ohms)		
		One Bond per Joint	Two Bonds per Joint	Three Bonds per Joint
#2 AWG	12 Inches	Not Allowed	259	173
#2 AWG	18 Inches	Not Allowed	388	259
#2 AWG	24 Inches	Not Allowed	518	346
#2 AWG	30 Inches	Not Allowed	647	432

      2) The CONTRACTOR shall remove and replace all joint bonds on a joint that exceeds the maximum allowable resistance. Replacement joint bonds shall be retested for compliance with the specified bond resistance.

   e. Record Tests of Each Bonded Metallic Pipeline Segment:
      1) Description and location of pipeline under test;
      2) Starting location and direction of test;
      3) Date of test;

4) Joint type;
5) Measured joint bond resistance using specified DLRO meter.

4. Testing After Backfill (Calculated Resistance Method or similar)

a. The pipeline shall be tested for electrical continuity along its entire length using the calculated resistance method or similar test plan developed under the direction of the CONTRACTOR's Cathodic Protection Specialist. The test plan shall be submitted to the ENGINEER and OWNER for approval prior to completing any testing.

b. If calculated resistance method is utilized:
   1) Apply suitable current (minimum 15 amps) along segments not to exceed 2,000 feet.
   2) Electrical resistance of the pipe shall be measured in sections for resistance of the pipe in sections for which the total length of pipe and the number of mechanical joints is known.
   3) The test station wires shall be used as the electrical contact points to the pipe for such measurements to facilitate repeating such measurements subsequent to backfilling.
   4) The electrical resistance obtained shall be compared with the calculated resistance for each section of piping. The calculated resistance shall be based on the resistance per unit length of pipe. Such resistance shall be a function of the resistivity and the cross sectional area of the metal conductor in the pipe wall, the length of pipe, the number of pipe joints, the resistance of the bond wires installed across the pipe joints, and the number of bond wires within the pipe length being measured.
   5) Measured resistance greater than 120 percent of the corresponding calculated resistance shall be reviewed and additional tests shall be made to determine the reason for the variation and the corrective measures required.

c. Record Tests of Each Bonded Pipeline:
   1) Description and location of pipeline under test;
   2) Starting location and direction of test;
   3) Date of test;
   4) Joint type and summary of calculated resistances;
   5) Measured joint bond resistance.

d. The CONTRACTOR shall assist the ENGINEER in the performance of such additional tests by providing electrical contacts and physical access to the pipe. This work, and any subsequent repairs and additional testing shall be performed at no additional cost to the OWNER.

e. The acceptable resistance value obtained prior to backfill shall be used as the standard for comparison for the resistance values subsequent to backfilling.

D. CP Commissioning and Testing:

1. Sacrificial Anodes:

a. Anode shall be activated when installed.

b. Testing to be performed by the CONTRACTOR's Cathodic Protection personnel.

c. Operating Test: Conduct a series of tests to demonstrate that equipment and material are installed correctly and operating properly for initial approval.
d. Functional testing (to be completed upon initial backfill):
    1) Commission all CP devices and measure native and polarized structure-to-soil potential of pipeline at each test station and cathodic protection device using applicable equipment. Include all test stations, isolation devices, bonded segments, above grade appurtenances, surrounding metallic structures, and other identified locations.
e. Final Testing (to be completed 30 days after backfill and functional testing and/or connections of all CP devices)
    1) Make adjustments in the output of the system; conduct sufficient testing throughout the network of protected structures and piping to ensure proper installation and cathodic protection levels.
f. Warranty Testing (to be completed 30 days prior to end of warranty period or approximately 1 year after installation)
    1) Make adjustments in the output of the system; conduct sufficient testing throughout the network of protected structures and piping to ensure proper installation and cathodic protection levels.
g. Locate, correct, and retest system defects or incomplete work identified
h. Provide a final chronological installation and testing report.
    1) Include:
        a) Locations of testing (stationing).
        b) Tabulated reports of the following:
            (1) Final anode current measurements
            (2) CP potential measurements
            (3) Insulated flanges / fittings testing with test methods indicated
            (4) Electrical continuity testing
            (5) All reports shall contain both stationary reference electrode readings and portable reference electrode readings.
        c) Changes, modifications, and alterations from plans.
        d) Comments relative to the Project.
        e) Failures and defects.
        f) Retesting information.

E. As-Built Records and Documentation:

1. As-Built records shall annotate all CP components and include the following as a minimum:

    a. Drawings showing location of each test station, anode, and insulated flanges / fittings.
    b. Drawings with sufficient information that each underground galvanic anodes can be exactly excavated or replaced such as GPS coordinates and true stationing.
    c. Drawings show the location of each field test station completed and description of the pipe lead wire connections.
    d. Records of all anode installation details.

- END OF SECTION –

SECTION 31 10 00 - SITE CLEARING

PART 1 -- GENERAL

1.1 DESCRIPTION

A. This section describes permanent and temporary easements, construction staking, and construction fencing.

B. This section describes clearing, grubbing, demolition, removal, and re-setting.

1.2 EXISTING CONDITIONS

A. Perform a thorough on-site inspection prior to construction to determine the actual condition of the site as it affects the work.

B. Do not damage structures, landscaping, or vegetation adjacent to the site. Repair or replace any damaged property at no additional cost to City of Thornton.

1.3 SEQUENCING

A. Conduct site clearing only after Work Limits fencing and erosion and sediment controls are in place. Comply with permit requirements and conditions.

PART 2 -- PRODUCTS

PART 3 -- EXECUTION

3.1 PERMANENT AND TEMPORARY EASEMENTS

A. City of Thornton's easements are available for use during construction as shown on the Drawings. Easements provide for the construction of proposed facilities, provide access to the construction site, and can be used as temporary storage space for construction equipment, piping materials, pipe bedding and backfill material, traffic control items, and other construction facilities, as shown on the erosion control drawings.

B. Restore easements used during construction to original grade and condition. Clear easements of construction materials and debris.

3.2 CONSTRUCTION STAKING

A. Stake the construction and establish temporary benchmarks, lines, levels, reference points, centerlines, and depths of cut. Verify dimensions in relation to connection with existing facilities. The CONTRACTOR is solely responsible for all errors in connection with this work.

B. Report any inconsistencies in the control survey to the ENGINEER prior to commencement of the work.

3.3 CONSTRUCTION FENCING

A. Erect orange construction fencing to fence off working areas. Construction fencing

shall incorporate a single strand tensioned wire to which top of fence is attached.

3.4 CLEARING AND GRUBBING

A. Unless otherwise specified, remove obstructions such as brush, logs, stumps, roots, heavy sod, vegetation, rock, stones larger than 6 inches in any dimension, broken or old concrete and pavement, debris, and structures where the completion of the work requires their removal.

B. Clear and grub to a minimum depth of 6-inches below subgrade.

C. Do not remove trees without City of Thornton's authorization.

3.5 DEMOLITION, REMOVAL, AND RE-SETTING

A. Structures

1. Demolition and removal of structures consist of abandoned superstructures, foundation walls, footings, slabs, and similar facilities where shown for removal on the Drawings. Unless otherwise indicated, haul and dispose demolished structures and appurtenances to an acceptable disposal facility offsite at no additional cost to City of Thornton. Clear waste, debris and loose soil caused by removal excavations and refill and compact the disturbed area.

2. Protect existing structures to prevent damage when temporarily removed in order to facilitate the completion of the work. Excavate, backfill, compact, and reset the structure back to its original or better conditions.

B. Miscellaneous Small Structures

1. Miscellaneous small structures consist of mail boxes, traffic and road signs, telephone pedestals, utility marker posts, and similar facilities. Unless otherwise indicated, haul and dispose demolished structures to an acceptable disposal facility offsite. Clear waste, debris and loose soil caused by removal excavations and refill and compact the disturbed area.

2. Protect existing structures to prevent damage when temporarily removed in order to facilitate the completion of the work. Excavate, backfill, compact, and reset the structure back to its original or better conditions.

C. Drainage Culverts

1. Drainage culverts consist of piping that may be constructed of corrugated metal, reinforced concrete, PVC, cast iron, or other material that conveys solely storm sewer. Irrigation ditches are not drainage culverts.

2. Protect existing drainage culverts to prevent damage when temporarily removed in order to facilitate the completion of the work. Excavate, bed, backfill, compact, and reinstall existing drainage culverts to their original invert elevations and original or better conditions. Replace with new gaskets matching the original.

D. Power Poles and Telephone Pedestals

1. Power poles and telephone shall only be relocated by the governing utility.

2. Coordinate with the utility owner directly on the temporary disruption and pay utility owner fees and costs at no additional expense to City of Thornton.

E. Fences

1. Fences may include types such as steel post and wire, wood post and board, wood post and rail, polyvinyl chloride or plastic, steel pipe, wood split rail, chain link, or wood panel fencing.
2. Coordinate fence removal and temporary replacement with property owner.
3. Protect existing fences to prevent damage when temporarily removed in order to facilitate the completion of the work. Excavate, backfill, compact, and reset the fence back to its original or better conditions.

F. Pavement

1. Protect streets, roads, and driveways used for construction of the project from damage by construction equipment and materials.
2. Repair damage to the pavement caused by construction activities at no additional cost to City of Thornton.
3. When portions of pavements must be removed and replaced to facilitate the work, saw cut edges to a neat line at right angles.
4. When required, remove and replace pavement in accordance with the governing jurisdiction requirements and inspections. Haul and dispose pavement materials to an acceptable disposal facility offsite at no additional cost to City of Thornton.

G. Salvage

1. City of Thornton has the right to salvage any component removed to facilitate the work.
2. Notify City of Thornton 5 days prior to salvage or demolition work to determine the disposition of items to be removed.
3. City of Thornton will mark items to be salvaged. Properly disconnect, remove, clean, and deliver to City of Thornton.

3.6 DISPOSAL

A. Clearing and grubbing debris

1. Dispose debris offsite. Limit offsite disposal to federal, state, or local approved locations.
2. Burning debris onsite is not allowed.

B. Strippings

1. Dispose strippings offsite that are unsuitable for topsoil or stream restoration material that exceed required quantity.
2. Stockpile topsoil or stream restoration material in sufficient quantity as required.

- END OF SECTION -

SECTION 31 23 00 - EXCAVATION & FILL

PART 1 -- GENERAL

1.1 SCOPE OF WORK

A. The work of this Section includes all earthwork required for construction of the pipeline. Such earthwork shall include, but not be limited to, the loosening, removing, loading, transporting, depositing, and compacting in its final location of all materials wet and dry, as required for the purposes of completing the work specified in the Contract Documents, which shall include, but not be limited to, the furnishing, placing, and removing of sheeting and bracing necessary to safely support the sides of all excavation; all pumping, ditching, draining, and other required measures for the removal or exclusion of water from the excavation; the supporting of structures above and below the ground; all backfilling around structures and all backfilling of trenches and pits; the disposal of excess excavated materials; handling and disposal of contaminated soils; borrow of materials to make up deficiencies for fills; and all other incidental earthwork, all in accordance with the requirements of the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Codes: All codes, as referenced herein, are specified in Section 01 42 19, Reference Standards and Abbreviations.

B. Commercial Standards:

ASTM C 117	Standard Test for Materials Finer than 75-um (No. 200 Sieve) in Mineral Aggregates by Washing.
ASTM C 136	Standard Method for Sieve Analysis of Fine and Course Aggregates.
ASTM D 75	Standard Practice for Sampling Aggregates.
ASTM D 422	Method for Particle-Size Analysis of Soils.
ASTM D 698	Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb (2.49-kg) Rammer and 12-in (304.8-mm) Drop.
ASTM D 1556	Test Method for Density of Soil in Place by the Sand-Cone Method.
ASTM D 1633	Test Method for Compressive Strength of Molded Soil-Cement Cylinders.
ASTM D 2487	Classification of Soils for Engineering Purposes.
ASTM D 2901	Test Method for Cement Content of Freshly-Mixed Soil-Cement.
ASTM D 2922	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
ASTM D 4253	Test Methods for Maximum Index Density of Soils Using a

Vibratory Table.

ASTM D 4254	Test Methods for Minimum Index Density of Soils and Calculation of Relative Density.
ASTM D 4318	Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

C. OSHA STANDARDS

Comply with all requirements of the most recent issue of the Occupational Safety and Health Act (OSHA) defined in the Federal Register, and all other rules and regulations. In the case of conflict between these specifications and OSHA rules and regulations, OSHA will take precedence. The Contractor's attention is directed to the latest provisions of Subpart P, Section 1926 of the OSHA Safety and Health Standards for Construction.

1.3 SUBMITTALS

A. Certify that a qualified individual designed the sheeting/shoring and trench support systems in accordance with the most recent OSHA and other governing rules and regulations.

B. Submit samples of materials in accordance with the requirements in Section 01 31 00, Submittals.

C. Submit means, methods and material specification for backfilling the newly constructed potable water transmission mains and appurtenances to the limits shown on the plans. Include information on set times and strength characteristics for fill material, placement of bulkheads, and methods for verifying fill quantities.

1.4 QUALITY ASSURANCE

A. General: All soils testing will be done by the Contractor. The Contractor shall submit qualifications to the Owner for review and approval. Costs of testing laboratory services shall be included in the Contract Price, except that any costs associated with re-testing or additional testing due to non-compliance with these specifications or any failed test shall be borne by the Contractor.

B. Where soil material is required to be compacted to a percentage of maximum density, the maximum density at optimum moisture content will be determined in accordance with ASTM D 698, except as otherwise stated in these specifications. Where cohesionless, free draining soil material is required to be compacted to a percentage of relative density, the calculation of relative density will be determined in accordance with ASTM D 4253 and D 4254. Field density in-place tests will be performed in accordance with ASTM D 1556, ASTM D 2922, or by such other means acceptable to the Engineer.

C. In case the tests of the fill or backfill show non-compliance with the required density, gradation, or other physical properties, accomplish such remedy as may be required to ensure compliance. Subsequent testing to show compliance shall be by a testing

laboratory provided by the Contractor, approved by the Owner, and shall be at the Contractor's expense.

D. Certify that all import materials meet the requirements of this Specification. Particle size analysis of soils and aggregates shall be determined in accordance with ASTM D 422.

E. Unified Soil Classification System: References in these specifications to soil classification types and standards set forth in ASTM D 2487 have the meanings and definitions indicated in the 1992 revision.

1.5 CLASSIFICATION OF EXCAVATION

A. Rock Excavation:

1. Rock excavation will be paid when the Contractor demonstrates that the material is not rippable using a Caterpillar 365 excavator or equivalent using a single ripper tooth.

   Rock excavation shall include removal and disposal of the following: (1) all boulders measuring one (1) cubic yard or more in volume; (2) all rock material in ledges, bedded deposits, and unstratified masses which cannot be removed without blasting, soundless chemical demolition agents, boom-mounted hydraulic impact hammers, hydraulic splitters or tractor-mounted impact rippers; (3) reinforced concrete structures which have been abandoned; and (4) conglomerate deposits which are so firmly cemented that they possess the characteristics of solid rock and which cannot be removed without soundless chemical demolition agents, boom-mounted hydraulic impact hammers, hydraulic splitters or tractor-mounted impact rippers.

2. Said rock excavation shall be performed by the Contractor. Payment will be made under a separate unit price bid for rock excavation.

B. All other excavation is unclassified.

1.6 PROTECTION

A. Sheeting and Bracing in Trench Excavation

1. Furnish, install, and maintain such sheeting and bracing as may be required to support the sides of excavations to prevent any movement which could in any way diminish the width of the excavation below that necessary for proper construction, and to protect adjacent structures from undermining or other damage. Prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and rammed.

2. Leave in place, to be embedded in the backfill, all sheeting and bracing which the Owner may require in writing, to be left in place at any time during the progress of the Work for the purpose of preventing injury to structures, utilities, or property, whether public or private. The Owner may direct that the sheeting and bracing be cut off at any specified elevation.

3. All sheeting and bracing not left in place shall be carefully removed in such a manner as to not endanger construction or other structures, utilities, or property. All voids left or caused by withdrawal of sheeting shall be immediately refilled with sand by ramming with tools especially adapted to that purpose, by watering or otherwise as may be directed.
4. No wood sheeting is to be withdrawn if driven below mid-diameter of any pipe, and under no circumstances shall any wood sheeting be cut off at a level lower than one foot above the top of any pipe.
5. The Contractor will be permitted to use steel sheeting in lieu of wood sheeting for the entire job whenever the use of sheeting is necessary. The cost for the use of sheeting will be included in the bid items for this pipe, and shall include full compensation for driving, bracing, and later removal of sheeting.
6. When moveable trench bracing such as trench boxes, movable sheeting, shoring, or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and/ or backfill.
7. Trench boxes, moveable sheeting, or plates shall not be allowed to extend below mid-diameter of the pipe. As trench boxes, movable sheeting, or plates are moved, bedding shall be placed to fill any voids created and the bedding and backfill shall be recompacted to provide uniform side support for the pipe.

PART 2 -- PRODUCTS

2.1. SUITABLE FILL AND BACKFILL MATERIAL REQUIREMENTS

A. General

Select or process clean fill, backfill, and embankment materials. Do not use wet, soft, or frozen material, asphalt and concrete chunks, cinders, ashes, refuse, vegetable or organic material, boulders, rocks, or other deleterious material as backfill.

B. Suitable Materials

Soils not classified as unsuitable as defined in Paragraph 2.2, "Unsuitable Material" herein, are defined as suitable materials and may be used in fills, backfilling, and embankment construction subject to the limitations specified herein. In addition, when acceptable to the Engineer, some of the material listed as unsuitable may be used when thoroughly mixed with suitable material to form a stable composite.

C. Suitable materials may be obtained from on-site excavations, may be processed on-site materials, or may be imported.

D. The following types of suitable materials are designated and defined as follows:

1. Trench Stabilization Material

A crushed, angular material meeting the requirements of Colorado Department of Transportation, Class B Filter material as follows:

Sieve Size	Percentage Passing
1-1/2-inch	100
No. 4	20 - 60
No. 16	10 - 30
No. 50	0 - 10
No. 200	0 - 3

2. Rockfill

   Urban Drainage and Flood Control District Type VL with modifications as follows:

Sieve Size	Percentage Passing
12-inch	70 -100
9-inch	50 - 100
6-inch	35 - 50
2-inch	2 – 10

3. Base Course

   Meet the requirements of Colorado Department of Transportation Aggregate Base Course Class 5 or 6 as follows:

	Percentage Passing	
Sieve Size	Class 5	Class 6
1-1/2-inch	100	--
1-inch	95-100	--
3/4-inch	--	100
No. 4	30 - 70	30 - 65
No. 8	--	25 - 55
No. 200	3 - 15	3 - 12
Liquid Limit (LL)	Less than 30	
Plasticity Index (PI)	Less than 6	

4. Bedding and Pipe Zone Material. The gradation requirements below meet City of Thornton Standards and Specifications Section 105.4 Pipe Bedding.

   Clean, well-graded, free-draining sand or squeegee sand with no clay fines meeting the following gradation requirements:

   Squeegee Sand

Sieve Size	Percentage Passing
3/8-inch	100
No. 200	0 – 3

5. Gravel Road/Shoulder Material

Meet the requirements of Colorado Department of Transportation Aggregate Base Course, Class 6 as follows:

Sieve Size	Percentage Passing
1-1/2-inch	--
1-inch	--
¾-inch	100
No. 4	30 – 65
No. 8	25 - 55
No. 200	3 - 12

6. Topsoil

   Topsoil, delineated from subsoil by a higher organic matter content (usually indicated by a darker color) and a relatively loose and friable soil structure, in open or unimproved areas or as determined in the field by the Owner.

7. Trench Zone Material

   Material not classified as unsuitable. Contractor shall utilize suitable spoil from other portions of the work where necessary to replace unsuitable trench zone material. Unsuitable material shall be hauled away and disposed of at Contractor's expense.

8. Structural Fill

   Well graded crushed rock or natural gravel meeting the following gradation requirements:

Sieve Size	Percentage Passing
2-inch	100
No. 4	30 - 100
No. 50	10 - 60
No. 200	5 - 20

9. Sitework Concrete: As specified in Section 03 31 00, Reinforced Concrete.

10. Flow Fill & Controlled Strength Material: A standard mix, commercially available material meeting the following requirements:
    a. 7-day Compressive Strength: Not less than 100 psi or not more than 200 psi. Determine in accordance with ASTM D4832.
    b. Batching Equipment: Provide to obtain the proper weights of soil, cement, and water. All measuring devices shall be sensitive to a 2% variation above or below the actual weights required.
    c. Mixers: Operate such that the slurry is discharged uniformly and consistent throughout each batch.
    d. Consistency: Such that the controlled strength material flows easily into all openings between the pipe and the lower portion of the trench. When trenches are on a steep slope, a stiffer mix may be required. When a stiffer

mix is used, vibrate to ensure the controlled strength material completely fills all spaces.

11. Concrete Cut-off Walls: Concrete cut-off walls shall be constructed per the details shown on the Drawings. Concrete shall be as specified in Section 03 31 00.

12. Overexcavation Replacement Material: Any material not classified as unsuitable, except in soft areas use trench stabilization material.

2.2 UNSUITABLE MATERIAL

A. Unsuitable material for fill, backfill and embankment materials, excepting topsoil includes:

1. Soils which, when classified under ASTM D 2487, fall in the classifications of Pt, OH, CH, MH, ML or OL or obvious clayey materials or expansive soils as determined by the Engineer.

2. Any soil that cannot be compacted sufficiently to achieve the percentage of maximum density specified for the intended use, shall be classed as unsuitable material.

3. Materials that are wet, soft, or frozen.

4. Materials containing asphalt, concrete chunks, cinders, ashes, refuse, vegetable or organic material, boulders, rocks or other deleterious material.

PART 3 -- EXECUTION

3.1 PIPELINE TRENCH EXCAVATION

A. General

Unless otherwise shown or specified, excavate for pipelines and utilities using open-cut trenches. All excavation shall be made to the lines and grades shown on the Drawings. All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing driving lanes of the adjacent roadways and specific property access drives. Hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire and police call boxes, or other utility controls shall be left unobstructed and accessible during construction.

B. Trench Excavation

Trench excavation shall include material of every description and of whatever substance encountered, except rock and boulders. Pavement shall be cut with a saw, wheel, or pneumatic chisel along straight lines before excavating.

Trenches shall be excavated to the depth indicated on the Drawings which shall be a minimum depth of 6-inches and a maximum of 8-inches below the bottom of the pipe. The sides of the trench shall be excavated and maintained as nearly vertical

as practical and shall be in accordance with the Occupational Safety and Health Administration (OSHA) regulations. The trench width at the bottom and at the top of the pipe zone shall be a minimum of 12-inches plus the outside diameter of the pipe, and a maximum of 36-inches plus the outside diameter of the pipe. Trench width shall provide sufficient space to allow for laying pipe, bracing, and for pumping and drainage facilities. The bottom of the excavations shall be firm and dry in all respects.

C. Open Trench

The maximum amount of open trench permitted in any one location during working hours shall be 300 feet, or the length necessary to accommodate the amount of pipe installed in a single day, whichever is greater. All trenches within traveled roadways shall be fully backfilled at the end of each day, including temporary asphalt surfacing. In areas outside of traveled roadways, the length of trench left open shall not exceed 200 feet nor the maximum allowed by the City of Thornton. Barricades, fencing, and warning lights meeting OSHA and the Manual on Uniform Traffic Control Devices requirements shall be provided and maintained.

At the conclusion of each day's work, the open trench areas shall be provided with temporary escape ramps for public safety and wildlife. Escape ramps shall provide a maximum 2:1 slope for escape.

D. Over-Excavation and Trench Stabilization

In all places where the bottom of the trench excavation is wet, soft or unstable and cannot satisfactorily support the pipe and as ordered by the Owner, over-excavate beyond the depth shown to the depth ordered and then backfill with Rockfill or Trench Stabilization Material with woven filter fabric such as Mirafi 500X to 6 inches below the pipe. Install the geotextile as recommended by manufacturer. Additional payment will be made per the unit price bid item for over-excavation.

E. Where pipelines are to be installed in embankment or structure fills, construct the fill to a level at least one foot above the top of the pipe before the trench is excavated.

F. Rock Excavation

Shale, ledge rock, boulders, and large stones shall be removed to provide six (6) inches of clearance on each side of and below all pipe and accessories. Excavation below subgrade in rock or in boulders shall be refilled to subgrade with Rockfill and thoroughly compacted. Blasting for excavation will not be permitted.

G. Surplus Excavation

All surplus excavated material shall be removed from the job site by the Contractor at the Contractor's expense.

3.2. OVER-EXCAVATION NOT ORDERED, SPECIFIED, OR SHOWN

Any over-excavation carried below the grade ordered, specified, or shown, shall be backfilled to the required grade with the specified material and compaction. Such work shall be performed by the Contractor at its own expense.

3.3. EXCAVATION IN UNIMPROVED AREAS

A. In unimproved areas, topsoil shall be stripped from the area of disturbance and stockpiled. Topsoil shall be removed by a grader or front-end loader. Under no circumstances should topsoil be removed under moist soil conditions. Topsoil should be placed to one side of the easement, piled parallel to the trench. The subsoil should be placed in between the topsoil and the trench, separate from the topsoil. Under no circumstances shall subsoil be mixed with or placed on top of topsoil. The topsoil shall be protected from contamination by subsoil material, weeds, or any other deleterious material, and from compaction by construction equipment and vehicles. Topsoil stockpiles shall be suitably protected from erosion by wind and water.

3.4 EXCAVATION IN VICINITY OF TREES

A. Except where trees are down to be removed, can shall be taken when excavating in the vicinity of trees.

3.5. DISPOSAL OF EXCESS CLEAN EXCAVATED MATERIAL

A. Clean excess excavated material and rock may be utilized as fill material. Contractor shall comply with all federal, state, county regulations, and city ordinances.

3.6 DISPOSAL OF PAVEMENT MATERIAL

A. Pavement material may be disposed of at a certified asphalt or concrete recycling center by the Contractor at the Contractor's expense. Pavement material not disposed of at a certified asphalt or concrete recycling center shall be disposed of in accordance with all federal, state, county and city ordinances by the Contractor at the Contractor's expense.

3.7 BACKFILL - GENERAL

A. Do not drop directly upon any structure or pipe. Do not place around or upon any concrete structure until the concrete has attained sufficient strength to withstand the loads imposed.

B. Except for rockfill or drainrock materials being placed in over-excavated areas in trenches, place backfill after all water is removed from the excavation.

3.8 COMPACTION

A. Each layer of material shall be mechanically compacted in maximum 8-inch lifts to the specified percentage of maximum density. Equipment that is consistently capable of achieving the required degree of compaction shall be used and each layer shall be compacted over its entire area while the material is at the required moisture content.

B. Jetting is acceptable only for granular pipe zone material in the pipe zone and only when used in conjunction with vibration. When CL and/or CH soils are exposed in the trench excavation and ground water is not present, water used for jetting with vibration shall be removed until after compaction and final backfill is complete.

C. Trench zone, final backfill, and base course materials shall not be jetted.

D. Compaction Requirements

1. The following minimum relative compaction requirements shall be in accordance with ASTM D 698. The minimum relative density requirements shall be in accordance with ASTM D 4253 and D 4254. Where agency or utility company requirements govern, the highest compaction standards shall apply.

LOCATION OR USE OF FILL	PERCENTAGE OF RELATIVE COMPACTION	PERCENTAGE OF RELATIVE DENSITY
Pipe bedding, pipe zone backfill and over-excavated areas.	95	70
Topsoil	85	N/A
Trench zone backfill, beneath roadways, sidewalks, paved or unpaved roadway shoulders, or irrigation ditches.	95	70
Trench zone backfill not beneath roadways, sidewalks, paved or unpaved roadway shoulders.	90	65
Embankments	95	N/A
Backfill beneath manholes and around all structures.	95	70
Aggregate base course, subbase, or surface course.	100	N/A
Drainrock.	N/A	80

2. Remove, replace, and re-compact pipe zone material that exhibits excessive pumping, as determined by the Owner.

E. If the allowable deflection specified for the pipe is exceeded, expose and re-round or replace the pipe, repair all damaged lining and coating, and reinstall the pipe zone material and trench backfill as specified.

3.9 PIPE TRENCH BACKFILL

A. Pipe Bedding

Pipe bedding as shown on the Drawings shall be pipe zone material placed and compacted as specified herein. After placing the bedding, perform a final trim for establishing grade, such that each pipe section when first laid will be continually in contact with the bedding along the extreme bottom of the pipe. Excavation for welding shall be made as necessary.

B. Pipe Zone Backfill

1. Pipe zone backfill, as shown on the drawings shall be pipe zone material.
2. The pipe zone shall be backfilled and compacted with the specified pipe zone material. Exercise care to prevent damages to the pipeline coating, cathodic bonds, or the pipe itself during the installation and backfill operations.
3. Place and spread evenly in layers. When compaction is achieved using mechanical equipment, do not exceed 6 inches uncompacted thickness.
4. Restrain all pipe as necessary to prevent movement during backfill operations.
5. Place material simultaneously in 6-inch horizontal lifts on both sides of pipe.
6. Thoroughly tamp each lift, including area under haunches, with handheld tamping bars supplemented by “walking in” and slicing material under haunches with a shovel to ensure that voids are completely filled before placing each succeeding lift.
7. After the full depth of the pipe zone material has been placed, compact the material by a minimum of three passes with a vibratory plate compactor only over the area between the sides of the pipe and the trench walls.
8. Do not use power-driven impact compactors to compact pipe zone material.
9. Where the material moisture content is below the optimum moisture content, add water until the proper moisture content is achieved.
10. Where the material moisture content is too high to permit the specified degree of compaction, dry the material until the proper moisture content is achieved.
11. When pipe zone compaction is achieved using jetting with vibration methods, each layer shall not exceed 2 feet in thickness prior to compaction. Compaction using jetting with vibration methods is only permitted in pipe zone.

C. Trench Zone Backfill

1. Trench zone backfill as shown on the drawings shall be suitable material placed and compacted as specified herein.
2. After the pipe zone backfill has been placed as specified above, and after any excess water has completely drained or been removed from the trench, backfilling of the trench zone may proceed.
3. Backfill material shall be replaced to a depth from which it was removed. Compaction of the backfill must prevent settling that will cause the profile of the disturbed area to be significantly lower than the grade of undisturbed adjacent land. Overall compaction of the top 24-inches shall not be restrictive to plant root growth.
4. Following compaction, backfill material shall be ripped, chiseled, and prepared for seeding and planting as specified.

D. Backfill beneath Paved Areas

Backfill below paved areas shall be brought up to the bottom of the aggregate base course. All areas to receive pavement or concrete shall be proof rolled prior to placement of these materials.

E. Topsoil

In unimproved or open areas, topsoil shall be redistributed over all disturbed areas as specified. Care shall be taken to conform to the required final grades.

F. Concrete Cut-off Walls

Concrete cut-off walls shall be placed as shown on the Drawings or directed by the Owner. Concrete cut-off walls shall be constructed per the details shown on the Drawings. Concrete shall be as specified in Section 03 31 00.

3.10 BACKFILL IN THE VICINITY OF STRUCTURES

A. Backfill beneath, around, and above structures shall be placed and compacted as specified herein.

B. Jetting with vibration shall not be allowed for compaction of fill on roofs or backfilling around structures except in the pipe zone.

C. Backfill below manholes and vaults shall be a minimum of 12-inches of structural fill. Backfill around and above manholes and vaults shall be suitable material.

3.11 EMBANKMENT CONSTRUCTION

A. The area where an embankment is to be constructed shall be cleared of all vegetation, roots and foreign material. Following this, the surface shall be moistened, scarified to a depth of 6 inches, and rolled or otherwise mechanically compacted. Embankment fill material shall be placed and spread evenly in approximately horizontal layers. Each layer shall be moistened or aerated, as necessary. Unless otherwise approved by the Owner, each layer shall not exceed 6 inches of compacted thickness. The embankment fill and the scarified layer of underlying ground shall be compacted to 95 percent of relative density (ASTM D698).

B. When an embankment fill is to be made and compacted against hillsides or fill slopes steeper than 4:1, the slopes of hillsides or fills shall be horizontally benched to key the embankment fill to the underlying ground. A minimum of 12-inches normal to the slope of the hillside or fill shall be removed and re-compacted as the embankment fill is brought up in layers. Material thus cut shall be re-compacted along with the new fill material at the Contractor's expense. Hillside or fill slopes 4:1 or flatter shall be prepared in accordance with Paragraph A, above.

C. Where embankment or structure fills are constructed over pipelines, the first 4 feet of fill over the pipe shall be constructed using light placement and compaction equipment that does not damage the pipe.

3.12 FLOW FILL & CONTROLLED STRENGTH MATERIAL

A. Placement

Controlled strength material shall be placed from one side of the pipe and rodded or vibrated, if necessary, so that it flows under the pipe until it appears on the other side. Controlled strength material shall then be added to both sides of the pipe and rodded or vibrated until it completely fills the space between the pipe and the lower portion of the trench or vault. Where required to prevent uplift, the controlled strength material shall be placed in two stages, allowing sufficient time for the initial set of the first stage before the remainder is placed. Controlled strength material shall be deposited as nearly as practicable in its final position and shall not disturb the pipe trench or cause foreign material to become mixed with the controlled strength material. Controlled strength material shall be brought to 12 inches above the top of the pipe. Backfill shall not be placed until the controlled strength material has reached the initial set. If it is anticipated that backfill will not be placed over the controlled strength material within 8 hours, a 6-inch minimum cover of moist backfill shall be placed over the controlled strength material. The moisture in the 6-inch minimum cover shall be maintained until additional backfill is placed. If the ambient temperature is 50°F or less, an additional 12-inch minimum cover of loose backfill shall be placed over the 6-inch moist backfill cover prior to the end of the working day.

B. Controlled strength material shall not be mixed or placed when the air temperature is below 40°F. If the temperature is 35°F or above, controlled strength material may be placed provided that the temperature is rising. Temperature of the controlled strength material shall be 50°F or greater at time of placement. If the Engineer determines that weather conditions are unsuitable, controlled strength material shall not be placed.

C. No controlled strength material shall be placed in pipe trenches when the trench bottom or walls are frozen or contain frozen materials. Backfill placed as cover over the controlled strength material shall not contain any frozen material.

3.13 COMPACTION TESTING REQUIREMENTS

A. Pipeline Trench Backfill Compaction Testing

The pipe trench backfill shall be tested at intervals not to exceed 100 lineal feet of trench length, with a minimum of two locations tested per day. At least two tests shall be taken at each location at varying depths within the trench backfill. If the first five test locations (10 tests) at the beginning of pipe installation meet the specified compaction, the interval between test locations shall be lengthened to 500 lineal feet of trench length, with a minimum of two locations tested per day, provided that the backfill material is consistent with the soil sample used to determine maximum density. If any compaction test at the 500 foot interval fails to meet the specified requirements, Contractor shall remedy the failed area and re-test at no cost to the Owner. Following a failed test, Contractor shall test at 100 lineal foot intervals until five consecutive test locations (10 tests) meet the specified compaction requirements, at which point, the test interval can be extended to 500 lineal feet.

B. Structure Backfill Compaction Testing

Backfill around structures shall be tested at one location for each individual structure. At least two tests shall be taken at each location at varying depths within the structure backfill. If any compaction test at a structure fails to meet the specified requirements, Contractor shall remedy the failed area and re-test at no cost to the Owner.

C. All compaction test reports shall be submitted directly to the Engineer on a daily basis.

- END OF SECTION -

SECTION 31 23 19 - DEWATERING AND DRAINAGE

PART 1 -- GENERAL

1.1 SCOPE OF WORK

A. Design, furnish, install, operate, monitor, maintain and remove a temporary dewatering system as necessary to lower and control water levels below subgrades of excavations to permit construction in the dry.

B. Provide, maintain and remove temporary surface water control measures adequate to drain and remove surface water entering excavations.

C. Collect and properly dispose of all discharge water from the dewatering and drainage systems.

1.2 DESIGN AND PERFORMANCE RESPONSIBILITY

A. Design and execute methods of controlling surface water and groundwater.

B. Contractor shall be solely responsible for damage to properties, buildings or structures, sewers and other utility installations, pavements and work that may result from Contractor's dewatering or surface water control operations.

C. Design review and field monitoring by Owner shall not relieve the Contractor of responsibility for the work.

D. Contractor will be responsible for obtaining the necessary construction dewatering permit and any costs for required testing in accordance with federal and state standards.

PART 2 -- MATERIALS

2.1 PVC Pipe

A. Pipe for observations wells, if required, shall consist of minimum 1-inch I.D. Schedule 80 PVC pipe and machine slotted PVC wellpoints, maximum size slot 0.020-in.

PART 3 -- EXECUTION

3.1 GENERAL

A. Control surface water and groundwater such that excavation to final grade is made in-the-dry, the bearing soils are maintained undisturbed and softening and/or instability or disturbance due to the presence or seepage of water does not occur. All construction and backfilling shall precede in-the-dry and flotation of completed portions of work shall not be permitted.

3.2 SURFACE WATER CONTROL

A. Construct surface water control measures, including dikes, ditches, sumps, and other

methods to prevent, as necessary, flow of surface water into excavations.

3.3 EXCAVATION DEWATERING

A. Provide and maintain proper equipment and facilities to remove promptly and dispose of properly all water entering excavations. Excavations shall be kept dry, so as to obtain a satisfactory undisturbed subgrade foundation condition until the fill, structure, or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural elevations.

B. Pipe and concrete shall not be laid in water or submerged within 24 hours after being placed. Water shall not flow over new concrete within four days after placement.

C. In no event, shall water rise to cause unbalanced pressure on structures until the concrete or mortar has set at least 24 hours. Prevent flotation of pipe by promptly placing backfill.

D. Dewatering shall at all times be conducted in such a manner as to preserve the natural undisturbed capacity of subgrade soils to proposed bottom of excavation. If the subgrade of the trench bottom or excavations becomes disturbed due to inadequate drainage, excavate below normal grade as directed by the Owner and refill with trench stabilization material as specified in Section 31 23 00 at the Contractor's expense.

E. Evaluate the impact of the anticipated subsurface soil/ water conditions on proposed method of excavation and removal of water.

F. Where groundwater level is above the proposed bottom of excavation level, it is expected that some type of pumped dewatering system will be required for pre-drainage of soils prior to final excavation and for maintaining the lowered groundwater level until construction has been completed to such an extent that the structure, pipeline, or fill will not be floated for otherwise damaged. It is further expected that the type of system, spacing of dewatering units and other details of the work will have to be varied depending on soil/ water conditions at a particular location.

G. Dewater and excavate in a manner which does not cause loss of ground or disturbance to the pipe bearing soil or soil which supports overlying or adjacent structures.

H. If dewatering does not properly dewater the trench as specified, install groundwater observation wells as directed by the Owner. Do not place any pipe or structure until the readings obtained from the observation wells indicated that the groundwater has been lowered a minimum of 6-in. below the bottom of the final excavation within the trench limits.

I. Dewatering units used in the work shall be surrounded by suitable filter sands and no fines shall be removed by pumping. Pumping from the dewatering systems shall be continuous until pipe or structure is adequately backfilled. Stand-by pumps shall be provided.

J. Water entering the excavation from precipitation or surface runoff shall be collected in the shallow ditches around the perimeter of the excavation, drained to sump and pumped from the excavation to maintain a bottom free from standing water.

K. Existing or new sanitary sewers shall not be used to dispose of drainage.

- END OF SECTION -

SECTION 31 25 00 - SOIL SURFACE EROSION CONTROL

PART 1 -- GENERAL

1.1 SCOPE

A. The following erosion control section addresses measures to prevent erosion during construction. Erosion control measures shall be performed as required herein and in accordance with the following:

D. Colorado Department of Public Health and Environment regulations and requirements including but not necessarily limited to construction dewatering.

1.2 RELATED SPECIFICATION SECTIONS

A. Division 1 Sections 01 14 00 Construction Constraints, 01 33 50 – Site Conditions Survey, Section 01 50 10 – Protection of Existing Facilities, Section 01 57 19 – Temporary Environmental Controls, and Section 32 90 00 – Revegetation.

1.3 SUBMITTALS

A. The following information shall be provided in accordance with Section 01 33 00:

1. The Contractor shall furnish a certificate with each delivery stating source, quantity, and type of material. All materials shall conform to specification requirements. All certificates shall be delivered to the Engineer at the time of each delivery.

B. Project Review:

1. If the Contractor chooses to make substitutions or modifications to the erosion control drawings included as part of the Contract Documents, he must obtain approval from the City of Thornton. No additional time or expense will be added to the Contract for this work.

2. The erosion control drawings included with this work have been approved by the City of Thornton, and local jurisdictions.

1.4 QUALITY ASSURANCE

A. All inspections herein specified will be made by the Owner or Owner's Representative. Inspections may be made at any time.

B. City of Thornton shall have jurisdiction over the Work.

PART 2 -- PRODUCTS

2.1 GENERAL

A. All materials shall be first-grade, commercial quality.

2.2 EROSION CONTROL MATERIALS

A. Material shall be installed where noted on plans and as specified herein and elsewhere in the Contract Documents. Installation should be in accordance with the manufacture's recommendations.

B. Silt Fence Fabric - Mirafi 100X material shall be used for silt fences. Mirafi prefabricated silt fence with posts pre-assembled is acceptable.

PART 3 -- EXECUTION

3.1 GENERAL

A. All construction related activities, including those specified herein, shall be completed within the limits of the work spaced identified on the drawings.

B. The Contractor shall protect the surrounding areas from disturbance due to construction activities and restore to existing condition any areas disturbed by construction activities to the satisfaction of the Authority Having Jurisdiction. The Contractor shall repair all BMPs that may be damaged by rain, hail, and/or snow storms.

C. The Contractor shall provide temporary fencing, barricades, covering, or other protection to preserve existing landscaping items and to protect adjacent properties and other structures when they may be damaged by the construction work.

D. The Contractor shall inspect all trees damaged by construction. Broken limbs shall be cut flush to the trunk or main branch with clean, sharp tools.

E. Waste materials shall be contained removed and disposed of legally and off property.

F. It shall be the responsibility of the Contractor to avail itself of any information regarding utilities which are in the area of work and to prevent damage to the same. The Contractor shall provide protection to the utilities as necessary.

G. Any unusual subsoil condition that will require special treatment shall be reported to the Engineer.

3.2 EROSION CONTROL

A. Erosion control measures shall be installed according to the drawings and in accordance with City of Thornton requirements.

3.3 CLEANUP

A. Silt fencing, straw bales, and other temporary erosions control measures should be removed and disposed of following site stabilization and successful revegetation. The City of Thornton will notify the Contractor on the timing of removal.

B. The Contractor shall clean up and remove unused or waste materials from the site and leave the area in a neat condition satisfactory to the Owner when the project is approved and completed.

3.4 MAINTENANCE

A. The Contractor shall continuously maintain all erosion and sediment control features so that they perform their intended function during all phases of construction and work suspensions.

B. The Contractor shall replace any materials or equipment it has damaged or which have been damaged by its employees or sub-contractors.

C. Partial utilization of the project shall not relieve the Contractor of any of the requirements contained in the Contract Documents.

D. Maintenance shall include, in addition to the foregoing, cleaning, the repair of erosion, and all other necessary maintenance work.

3.5 STABILIZATION

A. Clearing and grubbing operations shall be scheduled and performed so that grading operations and permanent stabilization measures can follow immediately thereafter if the project conditions permit. Otherwise, temporary stabilization measures may be required between successive construction stages. No payment will be made for additional work required because the Contractor has failed to properly coordinate the erosion control requirements. Upon failure of the Contractor to coordinate the permanent stabilization measures with the grading operations in a manner to effectively control erosion and prevent water pollution, the City of Thornton may suspend the Contractor's grading operations and withhold monies due to the Contractor on current estimates until such time that all aspects of the Work are coordinated in an acceptable manner.

- END OF SECTION -

SECTION 31 50 00 - EXCAVATION SUPPORT AND PROTECTION

PART 1 -- GENERAL

1.1 DESCRIPTION

A. SCOPE

1. This section specifies requirements for sheeting, shoring, and bracing of trenches greater than 4 feet in depth.

B. DESIGN REQUIREMENTS:

1. The Contractor shall design sheeting, shoring, and bracing in accordance with OSHA. The standards of design referred to in the Labor Code shall be those of OSHA.

2. Horizontal strutting below the barrel of a pipe and the use of pipe as support are not acceptable.

1.2 REFERENCES

A. This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
OSHA	Construction Safety Orders

PART 2 -- PRODUCTS

2.1 GENERAL

A. The Contractor shall submit as product data to the Owner information required by OSHA. Information shall be provided in accordance with Section 01 33 00 of this project manual.

PART 3 -- EXECUTION

3.1 GENERAL

A. The construction of sheeting, shoring, and bracing shall not disturb the state of soil adjacent to the trench and below the excavation bottom.

B. Trench sheeting below the top of a pipe shall be left in place.

3.2 SEQUENCE

A. Trench excavation shall not be started until the design for trench support has been accepted by the Owner.

- END OF SECTION -

SECTION 32 12 16 - ASPHALT PAVEMENT

PART 1 -- GENERAL

1.1 SCOPE OF WORK

A. The CONTRACTOR shall provide asphalt concrete pavement and aggregate base course, complete and in place, in accordance with the Contract Documents.

B. Asphalt for use in non-City of Thornton jurisdictions roadways (Adams County, City of Northglenn, CDOT etc) shall adhere to the stricter of this specification or the governing jurisdictions specification.

C. City of Thornton jurisdictions roadways shall be in accordance with the City of Thornton Street and Parking Facilities Construction, latest revision. Pavement thickness shall match or exceed the existing pavement thickness. Minimum thickness pavement shall be per City of Thornton Specification Section 500.

D. Asphalt for use in parking lots shall meet or exceed the original asphalt thickness.

E. Asphalt and aggregate quality and characteristics, mix design and placement of asphalt pavement shall meet the local jurisdiction standards.

F. REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

G. Commercial Standards:

AASHTO M 82	Cut-Back Asphalt (Medium Curing Type)
AASHTO M 140	Emulsified Asphalt
AASHTO M 208	Cationic Emulsified Asphalt
AASHTO M 226	Viscosity Graded Asphalt Cement
ASTM D 242	Mineral Filler for Bituminous Paving Mixtures
ASTM D 692	Coarse Aggregate for Bituminous Paving Mixtures
ASTM D 977	Emulsified Asphalt
ASTM D 1073	Fine Aggregate for Bituminous Paving Mixtures
ASTM D 1188	Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
ASTM D 1557	Moisture-Density Relations of Soils and Soil - Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in (45-mm) Drop7
ASTM D 2027	Cutback Asphalt (Medium Curing Type)
ASTM D 2397	Cationic Emulsified Asphalt
ASTM D 2726	Bulk Specific Gravity and Density of Compacted Bituminous Mixtures using Saturated Surface-Dry Specimens.
ASTM D 3381	Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 3515	Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.

1.2 CONTRACTOR SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 and shall include:

1. Source of materials.

2. Gradation, specific gravity, source and description of individual aggregates and the final blend.
3. Aggregate physical properties.
4. Source and Grade of Performance Graded Binder.
5. Proposed Job Design Mix: aggregate and additive blending, final gradation shown on a 0.45 power graph, optimum asphalt content.
6. Mixing and compaction temperatures used.
7. Mixture properties determined at a minimum of four asphalt contents and interpolated at optimum and graphs showing mixture properties versus asphalt content.

B. Suitability Tests of Proposed Materials: Tests for conformance with the Specifications shall be performed prior to start of the WORK. The samples shall be identified to show the name of the material, aggregate source, name of the supplier, contract number, and the segment of the WORK where the material represented by the sample is to be used. Results of all tests shall be submitted to the ENGINEER for approval. Materials to be tested shall include aggregate base, coarse and fine aggregate for paving mixtures, mineral filler, and asphalt cement.

C. Trial Batch: Before placing any paving material, a testing laboratory acceptable to the OWNER shall prepare a trial batch of asphalt concrete for each job-mix formula to be used by the CONTRACTOR for the work. The trial batch shall be prepared using the aggregates and asphalt cement proposed by the CONTRACTOR, and approved by the ENGINEER. The compacted trial batch shall provide a basis for computing the voids ratio, provide an indication of the optimum asphalt content, and establish a basis for controlling compaction during construction. The cost of not more than two laboratory trial batch tests will be paid by the OWNER but the CONTRACTOR shall be responsible for the materials. Performing and paying for any additional trial batch testing shall be the CONTRACTOR's responsibility.

1.3 QUALITY CONTROL

A. All samples and tests described herein shall be made in accordance with approved ASTM/AASHTO procedures. The CONTRACTOR shall provide for all testing laboratory services in connection with tests verifying conformance of proposed materials with project requirements. The OWNER shall provide for testing laboratory services in connection with tests on materials after incorporation into the project, on a first time basis only. The costs of any retesting, as required, shall be borne by the CONTRACTOR.

B. Minimum Project Testing shall be as follows:

1.	Gradation	1/1000 Tons or 1/project site
2.	Asphalt Content	1/1000 Tons or 1/project site
3.	In-Place Density	1/1000 Tons or min. 1/500 L.F. of paving (includes cores & comparative Lab densities)

PART 2 -- PRODUCTS

2.1 AGGREGATE BASE

A. Materials for aggregate base shall be in accordance with Section 31 23 00 - Earthwork.

2.2 PRIME COAT

A. Prime coat shall be MC-70 liquid asphalt complying with the requirements of ASTM D 2027. Grade MC-250 liquid asphalt may be used when acceptable to the ENGINEER.

2.3 TACK COAT

A. Tack coat shall be emulsified asphalt Grade SS-1h or CSS-1h diluted with one part water to one part emulsified asphalt and shall comply with the requirements of AASHTO M208 or M140 (ASTM D 977).

2.4 ASPHALT CEMENT

A. Asphalt Cement for permanent hot mix asphalt patching and asphalt overlay shall be AC-10 or AC-20 complying with the requirements of AASHTO M226 (ASTM D 3381), latest revision. The asphalt cement shall be homogeneous, free from water, and show no tendency to foam when heated to three hundred forty seven degrees Fahrenheit. The spot test shall be negative for all grades when conducted with a napthaxylene solvent containing not more than 10% xylene by volume.

   Asphalt cement shall not be heated during the process of its manufacture, storage or during construction to a temperature so as to cause the formation of carbonized particles. At no time shall the temperature of the asphalt cement be raised above three hundred seventy five degrees Fahrenheit after loading in a tank for transportation from the refinery to the purchaser.

B. Asphalt cement content for the asphalt overlay shall be 6% to 7% by weight of the mixture, dependent upon the requirements of the job mix formula

2.5 AGGREGATE

A. The coarse and fine aggregates for the asphalt concrete mixture shall be graded and combined in such proportions that the resulting composite blend meets the grading requirements of the job mix formula.

   Coarse aggregate (material retained on the No. 8 sieve) shall have a “Los Angeles Abrasion Test” (AASHTO T-96) percentage of wear not exceeding forty percent (40%). Fine aggregate (material passing the No. 8 sieve) shall have a maximum loss of 12% at five (5) cycles in a sodium sulfate solution by the “Soundness of Aggregate Test” (AASHTO T-104). The aggregate shall be free from clay balls, organic matter, or other deleterious substances. At least seventy percent of the aggregate retained on the No. 4 sieve shall have at least two (2) fractured faces.

B. Asphalt Patching Aggregate: The CONTRACTOR shall submit for approval a job-mix formula for the asphalt patching mixture. The aggregate material in the job mix formula shall be within the following limits:

Sieve Size	Total Percent Passing by Weight
3/4-inch	100
1/2-inch	70 – 95
3/8-inch	60 – 88
No. 4	44 – 72
No. 8	30 – 58
No. 30	12 – 34
No. 200	3 – 9

2.6 ASPHALT-AGGREGATE MIXTURE

A. The CONTRACTOR shall furnish a mix design for both the asphalt patching material and the asphalt overlay material from an approved independent testing laboratory. This job mix formula shall establish a single percentage of aggregate passing each required sieve size, a single percentage of bituminous material to be added to the aggregate, and a single temperature for the mixture at the discharge point of the plant.

B. Test Criteria for Asphalt Patching Job-Mix: The asphalt-aggregate mixture shall meet the following test criteria:

Stability (Marshall, AASHTO T-245)	2000 lb., minimum
Flow, 0.01-inch (Marshall, AASHTO T-245)	8 min. – 18 max.
Stability (Hveem, AASHTO T-246)	37, minimum
Swell, (Hveem, AASHTO T-246)	0.030 in. max.
Air Voids, total mix	3 to 6 percent
Index of Retained Strength (AASHTO T-165, T167)	80% minimum
Voids in Mineral Aggregate	14 percent, minimum
Minimum Asphalt Content	5.75 percent by weight of mixture

C. Asphalt Patching Mixture Tolerances: The following tolerances for the job-mix formula will be allowed per single test:

Passing Sieve	Percent
Maximum Size	plus or minus 0
Passing No. 8 and larger sieves	plus or minus 8
No. 8 to 200	plus or minus 6
Passing No. 200	plus or minus 3
Asphalt Content	plus or minus 0.5
Discharge Mix Temperature	plus or minus 20.5 degrees F

Results of single extraction and sieve tests shall not be used as the sole basis for acceptance or rejection of the mixture. Any variation from the job-mix formula greater than the tolerances shown above shall be investigated and the conditions causing the variations corrected.

2.7 ASPHALT PAVEMENT THICKNESS

A. Pavement thickness shall be as indicated on the Drawings.

PART 3 -- EXECUTION

3.1 HAULING EQUIPMENT

A. Trucks used for hauling the asphalt concrete mixture shall be equipped with tight, clean, smooth metal beds. The beds shall be coated with an oil or other approved material to prevent the mixture from adhering to the beds. Each load shall be covered with canvas or other suitable material of sufficient size to protect the material from inclement weather conditions, excessive temperature loss, or formation of cooled layers of mix in the truck.

3.2 PAVING MACHINES

A. Unless otherwise permitted by the ENGINEER, the mixture shall be spread by means of a self-propelled laydown machine equipped with a screed or strike-off assembly and capable of spreading and finishing the asphalt concrete mixture to line and grade in full lane widths.

B. The paver shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed. The mixture shall be dumped in the center of the hoppers and care exercised to avoid overloading and spilling over of the mixture onto the base.

C. The screed or strike-off assembly shall effectively produce finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

D. When laying mixtures, the paver shall be capable of being operated at the necessary forward speeds for satisfactory placement. The operation of the paver shall be such to attain continuous paving.

3.3 ROLLERS

A. Rollers shall be steel wheeled and/or pneumatic tire type and be in good condition, capable of reversing without backlash. They shall weigh not less than eight (8) tons. All rollers shall have a water system capable of keeping the wheels properly moistened to prevent adhesion of the mixture to the wheels.

3.4 SUBGRADE PREPARATION

A. The subgrade shall be prepared in accordance with Section 31 23 00 - Earthwork as applicable to roadways and embankments. The surface of the subgrade after compaction shall be hard, uniform, smooth and true to grade and cross-section. Subgrade for pavement shall not vary more than 0.02-foot from the indicated grade and cross section. Subgrade for base material shall not vary more than 0.04-foot from the indicated grade and cross section.

3.5 AGGREGATE BASE

A. Aggregate base shall be provided where indicated to the thickness indicated. Imported aggregate bases shall be delivered to the site as uniform mixtures and each layer shall be spread in one operation. Segregation shall be avoided and the base shall be free of pockets of coarse or fine material. Where the required thickness is 6 inches or less, the base materials may be spread and compacted in one layer. Where the required thickness is more than 6 inches; the base material shall be spread and compacted in two or more layers of approximately equal thickness, and the maximum compacted thickness of any one layer shall not exceed 6 inches. The relative compaction of each layer of aggregate base shall be not less than 95 percent of maximum density when measured in accordance with ASTM D 1557. The compacted surface of the finished aggregate shall be hard, uniform, smooth and at any point shall not vary more than 0.02 foot from the indicated grade or cross-section.

3.6 PAVING SURFACE

A. After the pavement base has been prepared, it shall be made ready for paving by clearing any loose material off and applying a prime coat as specified. The rate of application of the prime coat shall be 0.3 gallons per square yard. Edges of all contact surfaces such as curb and gutter, manholes, cross pans and other structures shall be coated with the prime coat material before paving. When more than one lift is required, a tack coat shall be used between courses of pavement at a rate of 0.1 gallons per square yard.

B. Asphalt concrete pavement shall be a minimum of two (2) inches compacted thickness and shall be laid in one (1) lift. If a thickness greater than three (3) inches is specified, separate courses shall be laid; each course shall be not less than one (1) inch compacted thickness, nor greater than three (3) inches compacted thickness.

3.7 SPREADING, FINISHING, AND COMPACTION

A. The mixture shall be laid upon the approved base surface, spread, and struck off to the grade and elevation required. Pavers shall be used to distribute the mixture over the entire surface except where hand placing is necessary.

B. The longitudinal and transverse joints shall be made in a careful manner, well bonded and sealed. Joints shall be coated with tack coat material.

C. In confined areas where mechanical pavers cannot be used, the mixture shall be spread, raked, screeded and luted with hand tools. When material is shoveled, it shall be deposited by turning the shovel over above the desired area. No “slinging” of the shovel will be permitted. The hand placed material shall be smoothed and left higher that the machine laid material by ¼ inch per inch of depth prior to rolling. If the machine laid mixture has been rolled, then the hand laid mixture shall be smoothed and left higher than the rolled pavement by ¼ inch per inch depth.

D. Segregation of materials shall not be permitted. If segregation occurs, the spreading operation shall be immediately suspended until the cause is determined and corrected.

E. Placing the mixture shall be as continuous as possible. All surface irregularities shall be adjusted by the addition or removal of mixture prior to rolling. After the mixture has been spread, struck off and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling.

F. The surface shall be rolled at the breakdown temperature determined at the beginning of the work. The breakdown temperature shall be such that the required density is obtained without displacement, cracking, or shoving of the mixture. The rollers shall operate at a speed slow enough to avoid displacements or "crawl" of the mixture. Any displacement shall be immediately corrected.

G. The number, weight, and type of rollers furnished shall be sufficient to obtain the required compaction while the mixture is in a workable condition. The minimum number of rollers shall be two. Heavy equipment or rollers shall not be allowed to stand on freshly placed pavement.

H. Unless otherwise directed, rolling shall begin at the sides and proceed longitudinally parallel to the street centerline, each pass overlapping one-half the roller width, gradually progressing to the crown of the street. When paving adjacent to a previously placed lane, the longitudinal joint shall be rolled first followed by the regular rolling procedure.

I. Rolling shall be continued until all roller marks are eliminated and no further compression is possible. The minimum density of the compacted mixture shall be 95% of the maximum density required to provide laboratory compacted specimen made in the same proportions as the job mix formula (AASHTO T-209).

J. Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective shall be removed and replaced with fresh hot mixture, which shall be compacted to conform with the surrounding area.

3.8 JOINTS

A. Transverse joints shall be formed by cutting through the previously laid course to expose the full depth of the course. A coat of tack coat material shall be used on contact surfaces of all joints just before additional mixture is placed.

3.9 WEATHER LIMITATIONS

A. The placing and compacting of asphalt surfacing shall be performed only when weather conditions are suitable. Asphalt surfacing shall not be placed on surfaces which are damp or wet nor when the temperature of the surface on which the asphalt pavement to be placed is less than 40 degrees Fahrenheit and the atmospheric temperature is less than 40 degrees Fahrenheit. The temperature of the mixture delivered to the jobsite shall not be less than 225 degrees Fahrenheit. When the atmospheric temperature is less than 50 degrees Fahrenheit, all loads shall be delivered continuously in covered vehicles.

3.10 SURFACE AND THICKNESS TOLERANCES

A. The surface of the finished pavement shall be free from depressions exceeding 3/16 inch in 10 feet, when tested with a straight-edge. All depressions exceeding the specified tolerances shall be corrected by removing defective work and replacing it with new material at the Contractor's expense.

3.11 PATCHING

A. Remove the backfill material to the depth and extent required to match the existing pavement. Prepare the sub-base as specified. The asphalt pavement shall be a minimum of four inches or equal to the existing pavement thickness, whichever is greater. The backfill and base coarse material shall be thoroughly compacted to the densities specified.

B. Existing pavement may be rough cut initially in conjunction with trenching; however, a square even vertical cut shall be made in the existing asphalt pavement after placement of backfill and prior to pavement replacement. The square vertical cut shall be made at a minimum of six (6) inches back from the trenchline into good pavement. Before placement of the new pavement, the cut edges shall be thoroughly cleaned and a tack coat shall be uniformly and evenly applied to vertical faces.

C. In large patches or whenever possible, a self-propelled paving machine shall be used to place the mixture. In small patches, the material shall be hand placed or placed with a spreader box without separation of the mixture. The material shall be placed to the grade and thickness required to allow for compaction after rolling. The hot mix material shall be compacted to provide 95% of the maximum density of a laboratory compacted specimen made in the same proportions as the job mix formula (AASHTO T-209). Rolling shall continue until all roller marks are eliminated and no further compression is possible in the pavement. After rolling the surface, a straight-edge or a stringline shall be used to check grade and riding quality of the patch.

- END OF SECTION -

SECTION 32 90 00 - REVEGETATION

PART 1 -- GENERAL

1.1 DESCRIPTION OF WORK

A. The work of this Section includes installation of sod and furnishing and drilling-in, placing or sowing seed within the pipeline relocation work areas as indicated on the Drawings and other areas disturbed during the course of the Work.

B. Related Specification Sections: 31 25 00 Soil Surface Erosion Control.

1.2 QUALITY ASSURANCE

A. Reference Standards: U.S. Department of Agriculture, Rules and Regulations under Federal Seed Act quality standards for Certified Seed.

B. City of Thornton or its Representative shall have final jurisdiction over the acceptance of the Work including but not limited to the proposed materials, proposed timing of installation, and acceptance of degree of stabilization achieved.

1.3 SUBMITTALS

A. Certificate of Inspection: Submit copies of invoices for materials, including seed, with State, Federal or other inspection certification and showing source of origin.

B. Signed statements certifying that the seed furnished is from a lot that has been tested by a recognized laboratory for seed testing within six months prior to delivery.

C. Seed tags and recalculated seed mixes per actual PLS for each genus/species must be submitted prior to seeding.

D. Sod supplier’s test reports and information on sod.

1.4 JOB CONDITIONS

A. Utilities: Determine location of underground utilities and drainage pipes and perform work in a manner which will avoid possible damage. Do not permit heavy equipment such as trucks, rollers or bulldozers to damage utilities or drainage system.

B. Any damage to utilities arising out of work of this section must be corrected and repaired by the Contractor to the satisfaction of the Construction manager.

C. It is assumed that, once earthwork has begun at any area, it will be pursued until completion. Completed sub-areas shall be stabilized by seeding or sod within fourteen calendar days of completion and these areas will be continuously maintained by the contractor until Final Acceptance of seeding or sod.

D. The areas that shall require revegetation are shown on the drawings.

PART 2 -- PRODUCTS

2.1 GRASS SEED

A. Seed Mix- Seed minimum 18-30 lbs PLS/Acre or 3 lbs PLS/1000 SF.

Table 1 Seed Mix – City of Thornton

Common Name	Scientific Name	Percentage
Western wheatgrass	*Pascopyrum smithii*	20%
Green needlegrass	*Nassella viridula*	5%
Sideoats grama	*Bouteloua curtipendula*	20%
Blue grama	*Chondrosum gracile*	29%
Buffalograss	*Buchloe dactyloides*	25%
Sand Dropseed		1%

B. Flower Mix- If required, addition per acre

Common Name	Quanitity
Prairie Coneflower	1 lb/Acre
Green needlegrass	2lb/Acre

C. Seed shall be furnished in sealed, unopened, standard containers labeled to clearly show the name and address of the supplier, the seed name, lot number, net weight, percent of weed seed content and the guaranteed percentage of purity and germination.

D. Seed and seed labels shall conform to all current state and federal regulations and will be subject to the testing provisions of the Association of Official Seed Analysis.

E. Seed shall be fresh, clean, pure live seed free from such noxious weeds as Russian or Canadian thistle, European bindweed, Johnson grass and leafy spurge.

F. Seed which has become wet, moldy, or otherwise damaged in storage or transit will not be acceptable.

G. If seed available on the market does not meet the minimum purity and germination percentages specified, Contractor shall compensate for a lesser percentage of purity and germination by furnishing sufficient additional seed to equal the specified product. Product comparison shall be made on the basis of pure live seed in pounds. The formula used for determining the quantity of pure live seed (PLS) shall be:
Pounds of Seed x (% Purity x % Germination) = Pounds of Pure Live Seed (PLS)

2.2 FERTILIZER AND ORGANIC MATTER

A. .

B. Organic matter defined as compost shall be Class 1 non-manure base compost

2.3 MULCH

A. Mulch shall be clean, weed free and seed free virgin wood fiber.

B. In areas that cannot be hydro-mulched, cover all seeded ground with 100% biodegradable straw blankets and blanket pins.

2.4 SOD

A. Sod replacement shall be commercially grown turfgrass blends to match existing turf. Drought tolerant cool season turf-type sod mixes may be substituted as approved by Owner.

B. Sod shall be healthy and certified by the State of Colorado as insect, disease, and noxious weed free. The cultivars that compromise each sod blend or mix must test well above average on the National Turfgrass Evaluation Program trials, as reviewed by the Owner. The sod shall be mowed at two inches and thoroughly watered before harvesting. Provide strongly rooted sod, not less than two years old, free of weeds, undesirable plants, insects, and other foreign materials and machine cut to pad thickness of ¾" (+1/4"), excluding top growth and thatch. Provide only sod capable of vigorous growth and development when planted (viable, not dormant).

1. Provide sod of uniform pad sizes with a minimum width of 16-inches and a minimum length of 24-inches with maximum 5% deviation in either length or width. Broken pads or pads with uneven ends will not be acceptable. Sod pads incapable of supporting their own weight when suspended vertically with a firm grasp on upper 10% of pad will be rejected.

PART 3 -- EXECUTION

3.1 PERMISSIBLE PLANTING TIMES

A. Irrigated grasses can be seeded at any time during the growing season. For best results, irrigated grasses should be seeded in May and no later than July. Seeding of non-irrigated grasses should occur between December 1st and May 1st. Deviation from these date ranges requires written consent of Construction Manager.

3.2 SEED BED INSPECTION

A. Contractor must examine the subgrade, verify the elevations, observe the conditions under which the work is to be performed, and notify the Construction Manager of unsatisfactory conditions. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the Construction manager.

B. Moisten prepared areas before planting if soil is very dry. Do not create a muddy soil condition or cause surface erosion.

C. Restore prepared areas to specified condition if eroded or otherwise disturbed after soil preparation and prior to seeding. Contractor is responsible for repairing/restoring grade at no additional cost to the Owner until placement of seed and mulch is

completed. Following placement of seed and mulch, damage to seedbed caused by excessive rain or snow runoff will be evaluated by Construction manager and Contractor for repair/restoration. Erosion or other damage to the final seedbed that are a result of Contractor activities will be repaired/restored at no additional cost to the Owner.

3.3 EXECUTION

A. Preparatory to seeding, all irregularities in the ground surface, except the saucers for trees and shrubs shall be removed. The surface shall then be brought to the desired line and grade. Fertilizer and organic matter shall be uniformly applied at the specified application rates and rototilled or disked to a depth of 6 inches. Necessary measures shall be taken to prevent the formation of low places and pockets where water will stand. Immediately prior to seeding, the ground surface shall be lightly tilled or hand worked into an even and loose seed bed having no lumps or stones over 3".

B. Seeding may be accomplished by means of mechanical power drawn drills followed by packer wheels, broadcast type seeders or other method acceptable to the Construction Manager. Hand broadcasting of seed will be permitted only on small areas not accessible to machine application, and shall be double the seeding rate.

C. Mechanical power drawn drills shall have depth bands set to maintain a planting depth of at least ¼ inch. Drilling shall be done in two separate applications crossing the area at right angles to one another to guarantee proper coverage. On sloping land, the Contractor shall conduct the final pass following the general contour of the land. Seed sown by broadcast type seeders shall be "raked in" or otherwise covered with soil to a depth of at least ¼ inch and rolled to obtain a firm seed bed. Water shall be applied when necessary.

D. Seeding of any kind will not be permitted during inclement or forecast of inclement weather, windy weather, when free surface standing water is present or when the ground is frozen or otherwise untillable.

3.4 MULCH

A. All seeded areas shall be mulched after seeding on the same day as the seeding.

B. Mulch shall be applied at the rate of 2-1/2 tons per acre and shall be attached by an approved method suitable for the type of mulch used. Mix water, 2000 lbs/Ac of mat fiber mulch and 100 lbs/Ac of tackifier, or at manufacturer's recommended rates, whichever is greater.

C. Mulch shall be spread uniformly, in a continuous blanket after seeding is complete by hand or blower-type mulch spreader.

D. Mulching shall be started on the windward side of relatively flat areas or on the upper part of a steep slope and continued uniformly until the area is covered. Mulch shall not be bunched.

E. Immediately following spreading, the mulch shall be anchored to the soil by a v-type wheel land packer or a scalloped-disk land packer designed to force mulch into the soil surface a minimum of 3 inches.

3.5 SODDING

A. Care and Handling

1. Care shall be exercised at all times to retain the soil on the sod roots during transportation, handling, and planting. Dumping sod from vehicles will not be permitted. The sod shall be installed within 24 hours from the time it is cut, unless it can be stored to the satisfaction of the Owner. During delivery and while in stacks, all sod shall be kept moist and protected from drying, sun, or freezing. All damaged sod shall be rejected. All sod discolored due to excessive drying shall be rejected.

B. Transporting Sod On-site

1. Sod can be transported on or across the site on pallets by forklift, bobcat, or equivalent. Damage to the sod bed by the vehicles shall be avoided. Any damage shall be repaired prior to sodding of the area. Damage caused to paving, curbs, fences, plants or other objects from sodding operations shall be remedied by the Contractor at his expense, as directed by the Owner.

C. Installation of Sod

1. Sod shall be laid on a firm, pre-moistened, but not wet, bed. Do not plant dormant sod or if ground is frozen. Prior to sod installation, the site shall be lightly irrigated to alleviate 'wicking' and plant material desiccation.
2. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod strips, do not overlap. Stagger strips to offset joints in adjacent courses. End joints shall be staggered at least 18-inches between adjacent rows. Sod roll length shall run perpendicular to all slope fall lines, with sod staples utilized on slopes, as necessary. Tamp or roll lightly to insure contact with subgrade. Work sifted soil into minor cracks between pieces of sod. Top-dress all joints with sand. Remove excess soil and sand to avoid smothering of adjacent grass.
3. Sod shall be laid flush with paving, curbs, and irrigation heads and one-inch below the top edge of steel edging. All rolls terminating at the project edge shall be cut in a straight line. No sod shall be installed within a radius of three feet around any tree.
4. Sod placed in drainage swales shall be staked, with stakes spaced not more than 30-inches apart, driven into the ground at an angle against the flow of water. Sodding shall begin at the bottom and progress upward, with strips laid perpendicular to the flow of water.
5. Water sod thoroughly with a fine spray immediately after planting.
6. Rolling: When soil and sod are moist, roll sod lightly as soon as possible after it is laid to eliminate air pockets and to provide a smooth and even surface.
7. Topsoil: Add along exposed edges to match adjacent grade. Feather topsoil out approximately 1 ft. from edge of sod.

8. Abutting existing sod: Provide a clean cut edge along existing sod where new sod will adjoin. Lay new sod to avoid any gaps, overlap, or unevenness.
9. Drainage: Assure finished areas of sod are such that positive drainage of storm and irrigation water will occur and ponding of water will be minimized.

D. Acceptance

1. Sod will be inspected at time of final walk through. Sod must be mowed within three days prior to this inspection.
2. Sod will be inspected for health, vigor, and quality of installation:
   a. All seams between sod pieces to be tight.
   b. Surface grade is to be smooth, without pits, humps, or pock marks.
   c. Sod must be free of weeds and undesirable grasses.
3. Settled sod areas shall be pulled, re-graded, and re-layed. Excessively shrunken sod (over ¾-inch shrinkage) shall be replaced with new sod.
4. Sod will not be accepted until after a minimum of two mowings have been completed and will remain under the one year warranty period.

3.7 SEED GERMINATION INSPECTION

A. The warranty period for the seed mix shall begin at the time of final completion and extend for the duration of forty-five (45) days. During this time, when germination is complete and plants are visible, the Construction Manager will perform a germination inspection. At this time, any areas which are thin, weak, dead or more than five percent weeds shall be rototilled and reseeded. All washouts shall be reseeded. No partial acceptances shall be made.

3.8 CLEANUP, PROTECTION, AND REPAIRS

A. Throughout the entire operation, rocks, clods and other debris shall not be allowed to accumulate, but shall be removed daily. The site shall be kept as tidy as possible at all times. Upon completion of the seeding all excess soils, rocks and debris which have not previously been cleaned up shall be removed from the site or disposed of as directed by the Construction manager. All ground areas disturbed as a result of seeding operations shall be restored to their original condition or to the desired finish grade.

- END OF SECTION -

SECTION 33 05 13 - MANHOLES, VAULTS AND STRUCTURES

PART 1 -- GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, and equipment required to install concrete manholes, vaults, structures, frames and covers, manhole steps, and appurtenances as shown on Drawings and as specified herein.

1.2 SUBMITTALS

A. Submit shop drawings, product data, materials of construction, and details of installation. Include the following:

1. Base sections, riser sections, eccentric conical top sections, flat slab tops, grade rings with notarized certificate indicating compliance with ASTM C478.

2. Pipe connections to manhole.

3. Manhole steps or ladders, including method of installation and notarized certificate including compliance with pull-out resistance test specified in this Section.

4. Manhole frame and cover with notarized certificate indicating compliance with ASTM A48, Class 30B.

5. Method of repair for minor damage to precast concrete sections.

B. Design Data

1. Precast concrete sections:

a. Sectional plan(s) and elevations showing dimensions and reinforcing steel placement.

b. Structural calculations including assumptions.

c. Concrete design mix.

C. Test Reports

1. Precast concrete sections:

a. Concrete test cylinder reports from an approved testing laboratory certifying conformance with specifications.

1.3 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A48 - Specification for Gray Iron Castings.

2. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

3. ASTM C32 - Specification for Sewer and Manhole Brick (Made from Clay or Shale).

4. ASTM C33 - Specification for Concrete Aggregates.

5. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale).

6. ASTM C150 - Standard Specification for Portland Cement.

7. ASTM C207 - Specification for Hydrated Lime for Masonry Purposes.

8. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

9. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.

10. ASTM D4101 - Specification for Propylene Plastic Injection and Extrusion Materials.

B. American Concrete Institute (ACI)

1. ACI 318 - Building Code Requirements for Reinforced Concrete

2. ACI 350R - Concrete Sanitary Engineering Structures

C. American Association of State Highway and Transportation Officials (AASHTO)

1. Standard Specifications for Highway Bridges

D. Occupational Safety and Health Administration (OSHA)

E. Where reference is made to one of the above standards, the revision in effect at the time of the contract shall apply.

1.4 QUALITY ASSURANCE

A. All material shall be new and unused.

B. Materials' quality, manufacturing process, and finished sections are subject to inspection and approval by Owner. Inspection may be made at place of manufacture, at work site following delivery, or both.

C. Materials will be examined for compliance with ASTM specifications, these Specifications and approved manufacturer's drawings. Additional inspection criteria shall include: appearance, dimension(s), blisters, cracks and soundness.

D. Materials shall be rejected for failure to meet any Specification requirement. Rejection may occur at place of manufacture, at work site, or following installation. Mark for identification rejected materials and remove from work site immediately. Rejected materials shall be replaced at no cost to Owner.

E. Repair minor damage to precast concrete sections by approved method, if repair is authorized by Owner.

PART 2 -- MATERIALS

2.1 GENERAL

A. Reference to a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

B. Like items of materials/equipment shall be the end products of one manufacturer in order to provide standardization of appearance, operation, maintenance, spare parts, and manufacturer's service.

C. Provide lifting lugs or holes in each precast section for proper handling.

2.2 PRECAST CONCRETE MANHOLE SECTIONS

A. Precast concrete riser sections, transition top sections, flat slab tops, and grade rings shall conform to ASTM C478 and meet the following requirements:

1. Top section shall be flat slab.

2. Base, riser, and transition top sections shall have tongue and groove joints.

3. Sections shall be cured by an approved method.

4. Precast concrete sections shall be shipped after concrete has attained 3,000 psi compressive strength.

5. Design precast concrete base, riser, transition top, flat slab top, and grade ring for a minimum H-20 loading plus earth load. Calculate earth load with a unit weight of 130 pcf.

6. Mark date of manufacture, name and trademark of manufacturer on the inside of each precast section.

2.3 PRECAST CONCRETE STRUCTURES

A. Precast reinforced concrete structures include rectangular vaults. Refer to Drawings for inside dimensions, headroom requirements, and minimum thickness of concrete.

B. Manufacturer shall notify Owner at least five working days prior to placing concrete during manufacturing process. Owner may inspect reinforcing steel placement prior to placing concrete.

C. Structural design calculations and Drawings shall be prepared and stamped by a Professional Engineer registered in the State of Colorado.

D. Design Criteria

1. Precast concrete

a. Minimum compressive strength shall be 4,000 psi.

b. Maximum water content shall be six gallons per 94 pound sack of cement.

c. Minimum cement content shall be six 94 pound sacks of cement per cubic yard of concrete.

2. Manufactured products

a. Conform to ACI 318 and ACI 350R.

b. Analyze walls and slabs using accepted engineering principals.

c. When ‘fy” exceeds 40,000 psi, “z” (ACI 318) shall not exceed 95,000 lb/in. “fs” shall not exceed 50 percent of “fy.”

d. Design products to support their own weight, weight of soil at 130 pcf, and a live load equal to AASHTO HS-20 applied to top slab.

e. Cast base slab and walls together to form monolithic base section.

f. Design structure walls for a water pressure assuming groundwater level at ground surface. Originate pressure diagram at finished ground surface. Include lateral pressure from vehicles in accordance with AASHTO.

g. Consider discontinuities in structure produced by openings and joints. Provide additional reinforcing around openings. Frame openings to carry full design loads to support walls.

h. Prevent flotation, with ground water level at finished ground surface, by dead weight of structure and soil load above structure. Do not consider skin friction, soil friction, or weight of equipment in structure.

i. Locate horizontal wall joints 18-in. minimum from horizontal centerline of wall openings.

j. Design structure with a minimum number of joints. Maximum number of structure sections, including top slab, shall be three.

k. Provide lifting hooks for top slab.

l. Locate access openings, wall sleeves, and pipe penetrations as shown on Drawings.

2.4 MANHOLE FRAME AND COVER

A. All heavy-duty manhole ring and covers shall be manufactured to meet H-20 traffic load conditions. Manhole frame and covers shall be free from scale, lumps, blisters, sand holes, and defects of any kind that render them unfit for the service for which they are intended. Manhole covers and frame seats shall be machined to a true surface. Castings shall be thoroughly cleaned and subject to hammer inspection. All rings shall be iron, manufactured according to ASTM Designation A48, Class 30B or better. All covers shall be ductile iron, manufactured according to ASTM Designation A539, Grade 60, or better.

B. All manhole assemblies shall be stamped with the name and model identification of the approved manufacturer.

2.5 JOINTING PRECAST MANHOLE SECTIONS AND STRUCTURES

A. Seal tongue and groove joints of precast manhole and structure sections with preformed flexible joint sealant. Preformed flexible joint sealant shall be Kent Seal No. 2 as manufactured by Hamilton-Kent; Ram-Nek as manufactured by K.T. Snyder Company or Tac-Tite as manufactured by Sheller-Globe.

B. Completed joint shall exhibit no leakage with visual observation.

B. Outside of joints shall be wrapped with con-seal or engineer approved equal.

2.6 MANHOLE STEPS

A. Manhole steps shall be cast in plastic coated steel, M.A. Industries No. PS2-PF, M. Bowden Co. BOWCD No. 93813, or Rubber-Delta Pipe Products WEDG-LOK SL-11.

2.7 VAULT PENETRATIONS

A. Pipe penetrations through manhole or vault walls shall be performed in the following manner:

1. Compression seal - Integrally cast sleeve in precast manhole or vault section or install sleeve in a form or cored opening. Install pipe through sleeve. Wrap the assembly around the pipe and connect first and last links. Slide the assembly into the space between the pipe and the sleeve. Tighten bolts to expand the links of the assembly to create a gas and water tight seal. Seal shall be rated at 20 psig hydrostatic pressure. Seal assembly shall be Link-Seal or approved equal.

B. Valve extension key holes shall be field cored for proper alignment with valve actuator. Key extension hole in concrete vault deck shall be located directly above valve actuator nut.

2.8 DAMPROOFING

A. Damproofing shall be Hydrocide 648 by Sonneborn Building Products; Dehydratine 4 by A.C. Horn Inc; RIW by Toch Brothers; MasterSeal 610, 614, 615 (formerly Hydrocide 700B), or equal.

2.9 BELOW GRADE INSULATION

A. Extruded polystyrene, ASTM C578, TYPE IV, 2-inch thick Styrofoam by Dow Chemical Co. or Formular by U.C. Industries, Inc.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Manhole and structure installation

1. Manhole and structure shall be constructed to the dimensions shown on Drawings and as specified in these Specifications. Protect all work against flooding and flotation.

2. Place manhole base on a bed of 12-in. structural fill. Set manhole base grade so that a maximum grade adjustment of 12-in. is required to bring the manhole frame and cover to final grade.

   Use precast concrete grade rings or brick and non-shrink mortar to adjust manhole frame and cover to final grade.

3. Set precast concrete barrel sections and structures plumb with a 1/4-in. maximum out of plumb tolerance allowed. Seal joints of precast barrel sections with preformed flexible joint sealant in sufficient quantity to fill 75 percent of joint cavity. Fill the outside and inside joint with non-shrink mortar and finished flush with adjoining surfaces. Caulk the inside of any leaking barrel section joint with lead wool or non-shrink grout to the satisfaction the Owner.

5. Plug holes in the concrete barrel sections required for handling with a non-shrinking grout or non-shrinking grout in combination with concrete plugs. Finish flush on the inside.

6. Cut holes in precast sections to accommodate pipes prior to setting manhole sections in place to prevent jarring which may loosen the mortar joints.

7. Backfill carefully and evenly around manhole sections.

B. Setting Manhole Frame and Cover

1. Set manhole covers and frames in a full mortar bed. Utilize precast concrete grade rings, a total of 8-in. thick, to assure frame and cover are set to the finished grade. Set manhole frame and cover to final grade prior to placement of permanent paving.

2. No grade rings shall be used in non-grade critical areas such as parks and open space, unless approved by owner.

C. Damproofing

1. Paint outer surfaces of precast and cast-in-place manholes and structures with two coats of bituminous damproofing at the rate of 30 to 60 sq ft per gallon, in accordance with manufacturer's instructions.

3.2 CLEANING

A. Thoroughly clean all new manholes of all silt, debris and foreign matter of any kind, prior to final inspections.

- END OF SECTION -

SECTION 33 11 01.01 - STEEL PIPE

PART 1 -- GENERAL

1.1 SCOPE OF WORK

A. This section of the specifications shall govern fabricating, furnishing, and installing mortar-lined steel pipelines and fittings including design and all appurtenant work.

1.2 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings in accordance with the requirements of ANSI/AWWA C200, C205, C207, C209, C210, C214 and C222, the following supplemental requirements as applicable:

1. Certified dimensional drawings of all fittings and appurtenances.

2. Joint and pipe/fitting wall construction details which indicate the type and thickness of cylinder; laying diagrams of all pipe, joints, bends, reducers, wyes, tees, crosses, outlets, manifolds, and other steel plate specials.

3. Fittings and specials details such as elbows, wyes, tees, outlets, connections, test bulkheads, and nozzles or other specials where shown on the Drawings which indicate amount and position of all reinforcement. All fittings and specials shall be properly reinforced to withstand the internal pressure, both circumferential and longitudinal, and the external loading conditions as indicated in the Contract Documents.

4. Information regarding location, types, size and extent of all welds.

5. Distinguish between shop and field welds.

6. Control joints or groups of joints in which welding sequence is especially important to minimize shrinkage stresses and distortion.

7. Specify the groove depths applicable for the effective throat required for the welding process.

8. Indicate welding positions and the details of the welded joints and the preparation of parent metal required to make them.

9. Joints meeting requirements under AWS D1.1, Section 3 shall be so noted on Shop Drawings. Joints not meeting this requirement shall be qualified as outlined in AWS D1.1, Section 4.

10. Design calculations including a complete stress analysis of each critical section of pipe wall, girth joints, and specials – all sufficient to ascertain conformance of pipe and fittings with the Specifications.

11. Material lists and steel reinforcement schedules which include and describe all materials to be utilized.

12. Line layout and marking diagrams which indicate the specific number of each pipe and fitting and the location of each pipe and the direction of each fitting in the completed line. In addition, the line layouts shall include: the pipe station and invert elevation at all changes in grade or horizontal alignment; the station and invert elevation to which the bell end of each pipe will be laid; all elements of curves and bends, both in horizontal and vertical alignment; and the limits of each reach or restrained and/or welded joints, or of concrete encasement.

13. Full and complete information regarding location, type, size, and extent of all welds shall be shown on the Shop Drawings. The Shop Drawings shall distinguish between shop and field welds. Shop Drawings shall indicate by welding symbols or sketches the details of the welded joints, and the preparation of parent metal required to make them. Joints or groups of joints in which welding sequence or technique are especially important shall be carefully controlled to minimize shrinkage stresses and distortion.

14. Submit as part of the Shop drawings a statement from the pipe fabricator certifying that all pipes will be fabricated subject to a recognized Quality Control Program. An outline of the program shall be submitted to the Engineer for review prior to the fabrication of any pipe.

15. Submit mill test, coil plant physical and chemical data before manufacture of pipe.

16. If requested by the Engineer, submit mill test data within one week of receiving coil and plant physical and chemical data within 4 weeks of conducting tests.

B. Certifications: Furnish a certified affidavit of compliance for all pipe and other products or materials furnished under this Section of the Specifications, as specified in ANSI/AWWA C200, C205, C209, C214, and C222 respectively, and the following supplemental requirements:

1. Physical and chemical properties of all steel, including mill certification for each heat from which steel is rolled.

2. Hydrostatic test reports.

3. Results of production weld tests.

4. Certifications for all welders.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

REFERENCE	TITLE
ANSI-B16.1	Cast Iron Pipe Flanges and Flanged Fitting, Class 25, 125, 250, and 800
ANSI B16.5	Steel Pipe Flanges, Flanged Valves, and Fittings
ANSI B16.9	Factory-Made Wrought Steel Buttwelding Fittings
ANSI B16.11	Forged Steel Fittings, Socket-Welding and Threaded
API Std. 1104	Field Welding of Steel Water Pipe
ASME B1.20.1	Pipe Threads, General Purpose (inch)
ASTM A36/A36M	Specification for Structural Steel
ASTM A47	Ferritic Malleable Iron Castings
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A105/A105M	Forgings, Carbon Steel, for Piping Components
ASTM A106	Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A139	Specification for Electric-Fusion (Arc)-Welded Steel Pipe (Sizes 4-inch and Over)
ASTM A283/A283M	Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars
ASTM A307	Specification for Carbon Steel Bolts and Studs
ASTM A325	Specification for High-Strength Bolts for Structural Steel Joints
ASTM A536	Ductile Iron Castings
ASTM A570/A570M	Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality
ASTM A572/A572M	High Strength Low Alloy Columbium-Vanadium Steels of Structural Quality
ASTM C150	Specification for Portland Cement
ASTM E165	Methods for Liquid Penetrant Inspection
ASTM E D1.1	Structural Welding Code – Steel

REFERENCE	TITLE
AWWA C200	Steel Water Pipe 6 Inches and Larger
AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe--4 In. and Larger--Shop Applied
AWWA C206	Field Welding of Steel Water Pipe
AWWA C207	Steel Pipe Flanges for Waterworks Services--Sizes 4 In. Through 144 In.
AWWA C208	Dimensions for Fabricated Steel Water Pipe Fittings
AWWA C209	Cold-Applied Tape Coating for Special Sections, Connections, and Fittings for Steel Water Pipelines
AWWA C210	Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipe
AWWA CC222	Polyurethane Coatings for Interior and Exterior of Steel Water Pipe and Fittings
AWWA C606	Grooved and Shouldered Joints
AWWA M11	Steel Pipe--A Guide for Design and Installation
SSPC-SP10	Near-White Blast Cleaning

1.4 QUALITY ASSURANCE

A. Pipe Manufacturer Qualifications:

1. Experienced in fabricating pipe of similar diameters, lengths, and wall thickness required for the Work.

2. Steel Pipe Fabricators Association (SPFA) or Lloyd's Registry Certification.

3. Demonstrate current production capability for volume of work required for this project.

4. Experience shall include successful fabrication to AWWA C200/C208 standards of at least 25,000 lineal feet, and a minimum of 25 fittings of 36-inch diameter or larger cement-mortar lined and polyurethane coated pipe, with wall thickness of 0.300-inches or greater, within past 5-year period.

5. Experience shall be applicable to fabrication plant facilities and personnel, not company or corporation that currently owns fabrication facility or employs personnel.

B. Inspection: All pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of AWWA C200, C205, C206, C207, C208, and C210 respectively, as supplemented by the requirements herein. Notify the Engineer in writing of the manufacturing starting date not less than 14 calendar days prior to the start of any phase of the pipe manufacture.

C. Tests: Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of AWWA C200, C205, C207, C208, and C210, as applicable.

1. After the joint configuration is completed and prior to lining with cement-mortar, each length of pipe of each diameter and pressure class shall be shop-tested and certified to a pressure of at least 80 percent of the yield strength of the pipe steel.

2. In addition to the tests required in AWWA C200, weld tests shall be conducted on each 500 feet of production welds and at any other times there is a change in the grade of steel, welding procedure, or welding equipment.

3. Each completed fabricated bend shall either be re-tested by the hydrostatic test method or shall have its mitered joints tested by the liquid penetrant method or where applicable by the soap and compressed air method.

D. Test Methods

1. Shop Hydrostatic Test: Vent all air from the pipe before the test pressure is applied. Hold the test pressure on each section for a sufficient length of time to permit inspection of all joints.

2. When subjected to the above hydrostatic test pressure, the pipe shall show no leaks, distortion, or other defects. Any leaks or other defects which develop during the hydrostatic test shall be repaired by chipping out and re-welding, after which the repaired section shall again be tested until it shows no leaks or other defects.

3. Test Bulkheads: Furnish and attach suitable dished heads and blind flanges for making the hydrostatic tests, and after completion of the tests, remove the heads and properly restore the ends of the sections.

4. Liquid Penetrant Test: Conform to the requirements specified in ASTM E 165, under Method A. The materials used shall be either water washable or nonflammable. Chip out all defects, re-weld and retest the section affected until it shows no leaks or other defects.

5. Soap and Compressed Air Test: Use forced compressed air at maximum 40-psi pressure into the joint, and while the joint is under pressure, swab every portion of every welded seam forming a part of the joint with a heavy soap solution or a commercial bubble-producing leak test fluid. Examine for leakage. Repair any defects disclosed by the test by chipping out, re-welding the chipped section, and re-testing. Drill and tap the necessary test holes as shown on the drawings, and plug weld the holes after testing.

E. No outside mortar or polyurethane coating shall be applied over a seam prior to testing; however, mortar lining may be applied over a seam prior to hydrostatic testing, but under such conditions said pressure test shall be held on the pipe or fitting for a period of not less than 30 minutes.

F. The Engineer shall have the right to witness all testing.

G. In addition to those tests specifically required, the Engineer may request additional samples of any material including mixed concrete and lining and coating samples for testing by the Owner.

H. Welding Requirements: All welding procedures used to fabricate pipe shall be prequalified under the provisions of AWS D1.1 or ASME. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.

I. Welder Qualifications: All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of AWS D1.1 or Section IX, Article III of the ASME Boiler and Pressure Vessel Code by an independent local, approved testing agency not more than 2 years prior to commencing work on the pipeline. Machines and electrodes similar to those used in the Work shall be used in qualification tests.

J. Inspection: Retain the services of trained technicians to field test the coating system by holiday detection and coating film thickness in accordance with Section 09 97 13.03, Steel Coatings - Polyurethane.

1.5 MANUFACTURER'S SERVICE REPRESENTATIVE

A. Furnishing the assistance of a manufacturer's service representative is advisable, in order to obtain perfect pipe joints, supports, or special connections. The Contractor shall furnish such assistance.

1.6 MATERIAL DELIVERY, STORAGE, AND PROTECTION

A. Deliver pipe, piping materials, fittings, valves, and accessories in a clean and undamaged condition and stored to provide protection against damage. All defective or damaged materials shall be replaced with new materials.

1.7 CLEANUP

A. After completion of the Work, all remaining pipe cuttings, joining and wrapping materials, and other scattered debris, shall be removed from the site. The entire piping system shall be handed over in a clean and functional condition.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Mortar-lined and dielectrically-coated steel pipe shall conform to AWWA C200, C205, and C222, subject to the following supplemental requirements. The pipe shall be of the diameter and minimum wall thickness shown, shall be furnished complete with welded joints, as indicated in the Contract Documents, and all specials and bends shall be provided as required under the Contract Documents. For pipe 14 inches in diameter and larger, the inside diameter after lining shall not be less than the nominal diameter specified or shown. Pipe smaller than 14 inches in diameter may be furnished in standard outside diameters according to AWWA.

B. Markings: Legibly mark all pipes and specials in accordance with the laying schedule and marking diagram. Each pipe shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation. All special pipe sections and fittings shall be marked at each end with top field centerline. The word “TOP” shall be painted or marked on the outside top spigot end of each pipe section.

C. Handling and Storage:

1. Handle the pipe using wide slings, padded cradles, or other devices designed and constructed to prevent damage to the pipe coating/exterior.

2. Do not use chains, hooks, or other equipment that might injure the pipe coating/exterior.

3. Use pipe handling equipment and methods acceptable to the Engineer.

4. Lift straight sections of pipe with two straps placed at approximate third points.

5. Prevent damage of the coating caused by handling and/or storage of the completed pipe at low temperature.

6. When being shipped and stock-piled at the factory, support each pipe on two 45-degree padded cradles, spaced at intervals not exceeding 20 feet. If pipe is stacked more than 2 high, provide 3 cradles, spaced 12 feet apart.

7. Support pipe stockpiled at the site on sand or earth berms free of rock exceeding 1-1/2 inches in diameter or on padded cradles.

8. Do not roll the pipe and secure to prevent accidental rolling.

9. Pad tie down devices in contact with the pipe.

D. Strutting: Adequate strutting shall be provided on all specials, fittings, and straight pipe so as to avoid damage to the pipe and fittings during handling, storage, hauling, and installation. For mortar-lined steel pipe, the following requirements shall apply:

1. The strutting shall be placed as soon as practicable after the mortar lining has been applied and shall remain in place while the pipe is loaded, transported, unloaded, installed and backfilled at the jobsite.

2. The strutting materials, size and spacing shall be adequate to support the earth backfill plus any greater loads which may be imposed by the backfilling and compaction equipment.

3. Any pipe damaged during handling, hauling, storage, or installation due to improper strutting shall be repaired or replaced.

4. The details of the strutting assembly shall be submitted for review by the Engineer prior to the start of pipe manufacture.

E. Laying Lengths: Maximum pipe laying lengths shall be 45 feet with shorter lengths provided as required.

F. Offset Tolerances: Shall be per requirements of AWWA C200.

G. Roundness Tolerances: Shall be per requirements of AWWA C200.

H. Lining: The pipe shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing and roughness.

I. Closures and Correction Pieces: Closures and correction pieces shall be provided as required so that closures may be made due to different headings in the pipe laying operation and so that correction may be made to adjust the pipe laying to conform to pipe stationing shown. The locations of correction pieces and closure assemblies shall be coordinated with the manufacturer. When field closures and field adjustments are required, cut and bevel pipe using automated machines assuring good workmanship.

2.2 PIPE DESIGN CRITERIA

A. Minimum wall thickness shall be as follows:

Nominal Pipe Diameter	Min. Wall Thickness
36” O.D.	0.188

B. The maximum working pressure of the 36-inch diameter Standley Lake pipeline is 77 psi based on the high-water level of Standley Reservoir (elevation 5,506 feet.)

2.3 MATERIALS

A. Cement: Cement for mortar shall conform to the requirements of AWWA C205, provided that cement for mortar lining shall be Type II, Type II-Modified, or Type V. A fly ash or pozzolan shall not be used as cement replacement.

B. Steel for Cylinders and Fittings: Provide steel coils for spiral welded steel pipe or steel sheet or plate for straight seam welded steel pipe per AWWA C200 and as follows:

1. Steel Sheet: Conform to the requirements of ASTM A1008, SS Grade 40 or 45, Type 2 or SS Grade 50.

2. Steel Plate: Conform to the requirements of ASTM A36, A516 Grade 70, or A572 Grade 42. Plate shall be fully-killed, conforming to ASTM A20, fine grained practice. Steel plates that are 3/4 inch thick or greater shall be normalized.

3. Steel Coil: Conform to the requirements of ASTM A139 Grade C or ASTM A1018, SS Grade 36, Type 2 modified, minimum tensile strength of 58K psi. Coil shall be continuous cast process, fully-killed, fine grained practice.

C. All steel used for the fabrication of pipe shall have a maximum carbon content of 0.25 percent, a maximum carbon equivalent of 0.45 percent, and shall have a minimum elongation of 22 percent in a 2-inch gage length.

D. All steel exceeding ½-inch in thickness used in fabricating pipe shall be tested for notch toughness using the Charpy V-Notch test. The steel shall withstand a minimum impact of 25 ft-lb. at a temperature of 30 degrees Fahrenheit.

E. Flanges: Flanges shall have flat faces and shall be attached with boltholes straddling the vertical axis of the pipe unless otherwise shown. Attachment of the flanges to the pipe shall conform to the applicable requirements of AWWA C207. Flanges for miscellaneous small pipes shall be in accordance with the standards specified for these pipes. Maximum allowable flange pressure ratings are as follows:

Flange Type	Maximum Allowable Pressure (psi)	
	Working	Test
AWWA C207		
Class B	86	107
Class D		
1-12 inches	175	218
14-144 inches	150	187
Class E	275	343
Class F	300	375
ANSI B16.5/B16.47		
Class 150	275	275
Class 300	720	720

F. Blind Flanges: Blind flanges shall be in accordance with ANSI/AWWA C207, or with the standards for miscellaneous small pipes. All blind flanges for pipe sizes 12 inches and over shall be provided with lifting eyes in the form of welded or screwed eyebolts.

G. Flange Coating: All machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.

H. Flange Bolts: All bolts and nuts shall conform to ASTM A307 unless noted otherwise. Studs and bolts shall extend through the nuts a minimum of 1/4-inch. All-thread studs shall be used on all valve flange connections, where space restrictions preclude the use of regular bolts.

I. Flange Gaskets: Unless otherwise required under the requirements of the Contract Documents, all specials and fittings shall be in accordance with Section 33 12 00 - Water Utility Distribution Equipment.

J. The coating system for straight line pipe shall be in accordance Section 09 97 13.03 Steel Coatings – Polyurethane. The polyurethane system shall meet the performance requirements as specified in AWWA C222.4.2 and shall be applied in accordance with AWWA C222, except as modified herein.

2.4 SPECIALS AND FITTINGS

A. Unless otherwise required under the requirements of the Contract Documents, all specials and fittings shall be in accordance with Section 33 11 01.03 - Steel Pipe-Fabricated Specials and shall conform to the dimensions of ANSI/AWWA C208.

2.5 DESIGN OF PIPE

A. General: The pipe furnished shall be steel pipe, mortar-lined, with field welded joints as shown. The pipe shall consist of a steel cylinder, shop-lined with portland cement-mortar or epoxy with an exterior coating of tape.

B. The pipe shall be designed, manufactured, tested, inspected, and marked according to applicable requirements previously stated and except as hereinafter modified, shall conform to ANSI/AWWA C200.

C. Joint Design: The standard field joint for steel pipe shall be single welded lap joints, and double lap welded joints for pipe located inside of casings. Mechanically coupled, or flanged joints shall be required where shown. Butt-strap joints shall be used only where required for closures or where shown. Double welded lap joints and butt-strap joints shall be tapped and drilled for testing in accordance with AWWA C206. The joints furnished shall have the same or higher pressure rating as the abutting pipe.

D. Lap joints prepared for field welding shall be in accordance with ANSI/AWWA C200. The method used to form, shape and size bell ends shall be such that the physical properties of the steel are not substantially altered. Unless otherwise approved by the Engineer, bell ends shall be formed by an expanding press or by being moved axially over a die in such a manner as to stretch the steel plate beyond its elastic limit to form a truly round bell of suitable diameter and shape. No process will be permitted in which the bell is formed by rolling. Faying surfaces of the bell and spigot shall be essentially parallel, but in no case shall the bell slope vary more than 2 degrees from the longitudinal axis of the pipe.

E. Shop-applied interior linings and exterior coatings shall be held back from the ends of the pipe as shown or as otherwise acceptable to the Engineer. All welds on interior of bells shall be ground smooth for a distance of 18 inches from pipe ends.

2.6 CEMENT-MORTAR LINING

A. Cement-Mortar Lining: Except as noted on the drawings or noted herein, interior surfaces of all steel pipe, fittings, and specials shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with ANSI/AWWA C205. During the lining operation and thereafter, the pipe shall be maintained in a round condition by suitable bracing or strutting. The lining machines shall be of a type that has been used successfully for similar work and shall be approved by the Engineer. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at delivery site, the damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications at no additional cost to the Owner.

B. The minimum lining thickness shall be as follows, with a tolerance of plus 1/8-inch or minus 1/16-inch:

Nominal Pipe Diameter (in)	Lining Thickness (in)
4-10	1/4
11-23	5/16
24-36	3/8
over 36	1/2

C. The pipe shall be left bare where field joints occur as shown. Ends of the linings shall be left square and uniform. Feathered or uneven edges will not be permitted.

D. Defective linings, as determined by ANSI/AWWA C205 or the Engineer, shall be removed from the pipe wall and shall be replaced to the full thickness required. Defective linings shall be cut back to a square shoulder in order to avoid feather edged joints.

E. The progress of the application of mortar lining shall be regulated in order that all hand work, including the repair of defective areas is cured in accordance with the provisions of ANSI/AWWA C205. Cement-mortar for patching shall be the same materials as the mortar for machine lining, except that a finer grading of sand and mortar richer in cement shall be used when field inspection indicates that such mix will improve the finished lining of the pipe.

F. Protection of Pipe Lining/Interior: For all pipe and fittings with plant-applied concrete or cement mortar linings, the Contractor shall provide a polyethylene or other suitable bulkhead on the ends of the pipe and on all special openings to prevent drying out of the lining. All bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe is installed.

G. Field-Applied Cement-Mortar Lining at Joints: Materials for field placement of cement-mortar lining at joints shall be in accordance with AWWA C205.

2.7 EXTERIOR COATING OF PIPE

A. Exterior Coating of Exposed Piping: The exterior surfaces of pipe which will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of rust-inhibitive primer conforming to the requirements of Section 09 97 13.03 Steel Coatings - Polyurethane.

B. Exterior Coating of Buried Piping: The coating system for buried pipe shall be in accordance Section 09 97 13.03 Steel Coatings - Polyurethane.

2.8 UNDERGROUND MARKING TAPE

A. Marking tape shall be 6-inches wide, blue background in color, with the following black lettering “CAUTION WATER LINE BURIED BELOW”. Marking tape shall be Empire Level Shieldtec or approved equivalent.

2.9 WAX TAPE COATING

A. Coat buried flanges, couplings, and valves with three-part, cold-applied wax tape coating system consisting of primer, wax tape, and tape outerwrap in accordance with NACE RP0375 and AWWA C 217.

B. Primer

Description: Blend of petrolatums, plasticizers, and corrosion inhibitors having paste-like consistency.
Acceptable materials: Trenton Wax-Tape Primer or Denso Paste.
Meet following properties:

Color	Brown
Pour Point	37.8°-43.3°C (100°-110°F)
Flash Point	176.7°C (350°F)
Coverage	0.41 L/M2 (1 gal/100 sq. ft.)

C. Wax Tape

Description: Plastic-fiber felt, saturated with blend of petrolatums, plasticizers, and corrosion inhibitors, forming tape coating that is easily formable over irregular surfaces.
Acceptable materials: Trenton Wax-Tape #1 for buried applications, Trenton Wax-Tape #2 for above ground applications, or Densyl.
Meet following properties:

Color	Purple
Saturant Pour Point	46.1°C – 48.9°C (115°– 120°F)
Thickness	Minimum 1.78 mm (70 mils)
Tape Width	150 mm (6 inches)
Dielectric Strength	170 volts/mil

D. Tape Outerwrap

Description: Polyvinylidene chloride plastic with three 50-gauge plies wound together as a single sheet.
Acceptable materials: Trenton Poly-Ply or Denso Ploy-Wrap.
Meet following properties:

Color	Clear
Thickness	0.0381 mm (1.5 mils)
Dielectric Strength	2000 volts/mil
Tape width	150 mm (6 inches)
Water Absorption	Negligible

E. Sources

The Trenton Corporation
Denso North America

PART 3 -- EXECUTION

3.1 REMOVAL OF EXISTING PIPE SECTIONS

A. The Contractor will provide Owner with a minimum of a two (2) week notice prior to desired shutdown period.

B. The Owner will perform the shutdown and dewatering of main line. Short sections of pipe may contain standing water, it is the Contractor's responsibility for local pipe section dewatering.

C. The Contractor is responsible for localized dewatering of pipe prior to removal of pipe sections.

3.2 INSTALLATION OF PIPE

A. Handling and Storage: All pipe, fittings, etc., shall be carefully handled and protected against damage to lining and coating/interior and exterior surfaces, impact shocks, and free fall. All pipe handling equipment shall be acceptable to the Engineer. Pipe shall not be placed directly on rough ground but shall be supported in a manner which will protect the pipe against injury whenever stored at the trench site or elsewhere. Pipe shall be handled and stored at the trench site in accordance with the Paragraph in Part 2 entitled "Handling and Storage." No pipe shall be installed where the lining surfaces show cracks that may be harmful as determined by the Engineer. Such damaged lining surfaces, shall be repaired, or a new undamaged pipe shall be furnished and installed.

B. The Contractor shall inspect each pipe and fitting to insure that there are no damaged portions of the pipe. The Contractor shall remove or smooth out any burrs, gouges, weld splatter or other small defects prior to laying the pipe.

C. Before placement of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance, which may have collected thereon and shall be

kept clean at all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption to the Work.

D. Pipe Laying: When the pipe is being laid, it shall be turned and placed where possible, so that any slightly damaged portion will be on top. The damaged area shall be repaired for the protection of any exposed steel. All damaged areas shall be repaired using materials and methods acceptable to the Engineer.

E. Pipe shall be laid directly on the imported bedding material. No blocking will be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations and for application of coating on field joints.

F. Each section of pipe shall be laid in the order and position shown on the laying schedule. In laying pipe, it shall be laid to the set line and grade, within approximately one inch plus or minus. On grades of zero slope, the intent is to lay to grade.

G. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the Engineer may change the alignment and/or the grades. Such change shall be made by the deflection of joints, adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed 75% of the maximum deflection recommended by the pipe manufacturer. No joint shall be misfit any amount which will be detrimental to the strength and water tightness of the finished joint. In all cases the joint opening, before finishing with the protective mortar inside the pipe, or prior to applying in-place mortar lining, shall be the controlling factor.

H. Except for short runs which may be permitted by the Engineer, pipes shall be laid uphill on grades exceeding 10 percent. Pipe which is laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement. All bends shall be properly installed as shown.

I. Struts in pipe smaller than 42 inches may be removed immediately after laying, provided, that the deflection of the pipe during and after backfilling does not exceed that specified. After the backfill has been placed, the struts shall be removed and shall remain the property of the Contractor.

J. Cold Weather Protection: No pipe shall be installed upon a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation. No pipe shall be laid unless it can be established that the trench will be backfilled before the formation of ice and frost occurs.

K. Pipe and Specials Protection: The openings of all pipe and specials where the pipe and specials have been cement mortar lined in the shop shall be protected with suitable bulkheads to maintain a moist atmosphere and to prevent unauthorized

access by persons, animals, water or any undesirable substance. The bulkheads shall be so designed to prevent drying out of the interior of the pipe. The Contractor shall introduce water into the pipe to keep the mortar moist where moisture has been lost due to damaged bulkheads. At all times, means shall be provided to prevent the pipe from floating.

L. Pipe Cleanup: As pipe laying progresses, the Contractor shall keep the pipe interior free of all debris. The Contractor shall completely clean the interior of the pipe of all sand, dirt, mortar splatter and any other debris following completion of pipe laying, pointing of joints and any necessary interior repairs prior to testing and disinfecting the completed pipeline.

3.3 WELDED JOINTS

A. General: Field welded joints shall be in accordance with ANSI/AWWA C206.

B. Where exterior welds are performed, adequate space shall be provided for welding and inspection of the joints.

C. During installation of welded steel pipe in either straight alignment or on curves, the pipe shall be laid so that at any point around the circumference of the joint there is a minimum lap of 1/2-inch and a minimum space of 3/4-inch plus the thickness of the steel pipe wall between the spigot end of the pipe and the nearest tangent to a bell radius.

D. An 18-inch minimum wide strip of heat resistant material shall be draped over the top half of the pipe on each side of coating holdback during welding to avoid damage to the coating by hot weld splatter. Welding grounds shall not be attached to the coated part of the pipe.

E. Butt straps shall be a minimum of 12-inches wide, and of 3/8-inch thickness and shall provide for a minimum of 3-inch lap at each pipe joint.

F. After the pipe and pipe joint are properly positioned in the trench, the length of pipe between joints shall be backfilled to at least one foot above the top of the pipe. Care shall be exercised during the initial backfilling to prevent movement of the pipe and to prevent any backfill material from being deposited on the joint.

G. To control temperature stresses, the unbackfilled joint areas of the pipe shall be shaded from the direct rays of the sun by the use of properly supported awnings, umbrellas, tarpaulins, or other suitable materials for a minimum period of 2 hours prior to the beginning of the welding operation and until the weld has been completed. Shading materials at the joint area shall not rest directly on the pipe but shall be supported to allow air circulation around the pipe. Shading of the pipe joints need not be performed when the ambient air temperature is below 55 degrees F.

H. Prior to the beginning of lap welding procedure, any tack welds used to position the pipe during laying shall be removed. Any annular space between the faying surfaces of the bell and spigot shall be equally distributed around the circumference of the joint by shimming, jacking, or other suitable means. The weld shall then be made in accordance with ANSI/AWWA C206. Where more than one pass is

required, each pass except the first and final one shall be peened to relieve shrinkage stresses; and all dirt, slag, and flux shall be removed before the succeeding bead is applied.

I. Prior to butt welding, the pipe and pipe joint shall be properly positioned in the trench using line up clamps so that, in the finished joint, the abutting pipe sections shall not be misaligned by more than 1/16-inch.

J. Following testing of the joint, the exterior joint spaces shall be coated in accordance with these specifications after which backfilling may be completed.

K. Qualifications of Procedures and Welders: All welding procedures used to install pipe shall be prequalified under provisions of AWS D1.1 or ASME. Welding procedures shall be required for field attachments and field welded joints.

L. Joints: The pipe ends shall be cut straight on joints where butt straps are used for realignment, adjustment, or deflection, and fillet welds shall be made as shown. Beveled ends for butt welding shall conform to ANSI B16.25. Contractor shall provide an automated machine for field mitering beveled ends for butt welding.

M. Field welded lap joints shall be full fillet welds on the inside and outside of the joint (double welded lap joint). Field double welded lap joints shall be full fillet welds on the inside and outside of the joint. Double welded lap joints and butt-strap joints shall be tapped and drilled for testing in accordance with AWWA C206.

N. Inspection of Field Butt Welded Joints: All field butt welds shall be inspected as soon as practicable after the welding of the field joint is completed. The Owner's independent testing laboratory shall inspect the joint by radiographic methods in accordance with API Standard 1104. All welds that are defective welds, or have defects, shall be removed and that section of joint shall then be rewelded. After the repair is made, the joint shall be checked by repeating the original test procedure, at no expense to the Owner.

O. Repair of Welds: All welds that are defective shall be repaired by the Contractor to meet the requirements of the applicable sections of these specifications. Defects in welds or defective welds shall be removed, and that section of the joint shall then be rewelded. Only sufficient removal of defective material that is necessary to correct the defect is required. After the repair is made, the joint shall be checked by repeating the original test procedure. Welds deficient in size shall be repaired by adding weld metal.

3.4 JOINT COATING AND LINING

A. General: The interior and exterior joint recesses shall be thoroughly wiped clean and all water, loose scale, dirt and other foreign material shall be removed from the inside surface of the pipe.

B. Coating of Fittings and Specials: Fittings and specials shall be coated in accordance with Section 09 97 13.03 Steel Coatings - Polyurethane.

B. Coating Repair: Coating repair shall be made in accordance with the pertinent specifications.

C. Joint Lining: After the backfill has been completed to final grade, the interior joint recess shall be filled with mortar lining meeting the requirements of AWWA C205. The mortar shall be tightly packed into the joint recess and troweled flush with the interior surface, and all excess shall be removed. At no point shall there be an indentation or projection of the mortar exceeding 1/16-inch. With pipe smaller than 24 inches in diameter, before the spigot is inserted into the bell, the bell shall be daubed with mortar containing one part cement to 2 parts sand. The spigot end then shall be forced to the bottom of the bell and excess mortar on the inside of the joint shall be swabbed out.

E. Field Exterior Joint Coating: shall be heat shrinkable sleeves with the following coating system:

1. Coating system:

a. Primer: 1027
b. Mastic: 939

2. Total minimum thickness: 180 mils

F. Coat buried and vaulted fasteners, flanges, couplings, and valves with cold-applied wax tape coating system such as Trenton #1wax tape in accordance with manufactures instructions, NACE RP0375, and AWWA C 217.

3.5 INSTALLATION OF PIPE APPURTENANCES

A. Before the joint is assembled, the flange faces shall be thoroughly cleaned of all foreign material with a power wire brush. The gasket shall be centered and the connecting flanges drawn up watertight without unnecessarily stressing the flanges. All bolts shall be tightened in a progressive diametrically opposite sequence and torqued with a suitable, approved and calibrated torque wrench. All clamping torque shall be applied to the nuts only.

3.6 CORROSION CONTROL

A. Cathodic Protection: Corrosion mitigation and testing materials, such as magnesium anodes, reference electrodes, and test lead wires shall be installed where shown and in accordance with Section 26 42 00 Cathodic Protection.

- END OF SECTION -

SECTION 33 11 01.03 - STEEL PIPE - FABRICATED SPECIALS

PART 1 -- GENERAL

1.1 SCOPE OF WORK

A. The Contractor shall fabricate, install, and test all bends, reducers, wyes, tees, crosses, outlets, manifolds and other steel plate specials, complete in place in accordance with the requirements of the Contract Documents.

1.2 SUBMITTALS

A. Shop Drawings

The Contractor shall submit shop drawings and laying diagrams of all pipe, joints, bends, reducers, wyes, tees, crosses, outlets, manifolds, and other steel plate specials.

B. Fittings and specials details such as elbows, wyes, tees, outlets, connections, test bulkheads, and nozzles or other specials where shown on the Drawings which indicate amount and position of all reinforcement. All fittings and specials shall be properly reinforced to withstand the internal pressure, both circumferential and longitudinal, and the external loading conditions as indicated in the Contract Documents.

Design calculations including a complete stress analysis shall be submitted to the Engineer for review prior to manufacture of pipe specials.

C. Certifications

A certified affidavit of compliance shall be furnished for all steel plate specials and other products or materials furnished under this section of the specifications.

1.3 REFERENCE STANDARDS

A. Commercial Standards

ANSI/AWWA C200	Steel Water Pipe 6 In and Larger
ANSI/AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 in and Larger - Shop Applied
ANSI/AWWA C207	Steel Pipe Flanges for Waterworks Service - Sizes 4 Inch Through 144 inch.
ANSI/AWWA C208	Dimensions for Fabricated Steel Water Pipe Fittings.
ANSI/AWWA C222	Polyurethane Coatings for Interior and Exterior of Steel Water Pipe and Fittings
ASTM A234	Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM C150	Specification for Portland Cement

AWWA M-11 Steel Water Pipe - A Guide for Design and Installation

1.4 QUALITY ASSURANCE

A. Fittings and Specials Fabricator:

1. Experienced in fabricating fittings and specials of similar diameters and wall thickness required for the Work.

2. Steel Pipe Fabricators Association (SPFA) or Lloyd's Registry Certification or ISO 9001:2008.

3. Demonstrate current production capability for volume of work required for this project.

4. Experience shall include successful fabrication to AWWA C200/C208 standards of at least 25 fittings of 60-inch diameter or larger pipe, with wall thickness of 0.275-inches or greater, within past 5-year period.

5. Experience shall include successful fabrication of at least 5 crotch plate fittings or specials requiring post weld heat treatment within past 5-year period.

6. Experience shall be applicable to fabrication shop facilities and personnel, not company or corporation that currently owns fabrication facility or employs personnel.

B. General

After completion of fabrication and welding in the shop, and prior to the application of any lining or coating, test each component according to the following requirements.

C. Test Requirements - Shop

1. Test each section of steel pipe used to fabricate specials by the hydrostatic test per Section 33 11 01.01.

2. Each completed fabricated bend shall either be re-tested by the hydrostatic test method or shall have its mitered joints tested by the liquid penetrant method or where applicable by the soap and compressed air method.

D. Test Methods

1. Shop Hydrostatic Test: Vent all air from the pipe before the test pressure is applied. Hold the test pressure on each section for a sufficient length of time to permit inspection of all joints.

2. When subjected to the above hydrostatic test pressure, the pipe shall show no leaks, distortion, or other defects. Any leaks or other defects which develop during the hydrostatic test shall be repaired by chipping out and re-welding, after which the repaired section shall again be tested until it shows no leaks or other defects.

3. Test Bulkheads: Furnish and attach suitable dished heads and blind flanges for making the hydrostatic tests, and after completion of the tests, remove the heads and properly restore the ends of the sections.

4. Liquid Penetrant Test: Conform to the requirements specified in ASTM E 165, under Method A. The materials used shall be either water washable or nonflammable. Chip out all defects, re-weld and retest the section affected until it shows no leaks or other defects.

5. Soap and Compressed Air Test: Use forced compressed air at maximum 40-psi pressure into the joint, and while the joint is under pressure, swab every portion of every welded seam forming a part of the joint with a heavy soap solution or a commercial bubble-producing leak test fluid. Examine for leakage. Repair any defects disclosed by the test by chipping out, re-welding the chipped section, and re-testing. Drill and tap the necessary test holes as shown on the drawings, and plug weld the holes after testing.

E. No outside mortar, tape or polyurethane coating shall be applied over a seam prior to testing; however, mortar lining may be applied over a seam prior to hydrostatic testing, but under such conditions said pressure test shall be held on the pipe or fitting for a period of not less than 30 minutes.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Specials are defined as fittings, closure pieces, bends, reducers, wyes, tees, crosses, outlets, manifolds, and other steel plate specials wherever located, and all piping above ground or in structures.

2.2 DESIGN

A. Design

Steel specials shall match wall thickness of the pipe in Section 33 11 01.01 Steel Pipe

2.3 FABRICATION AND MATERIALS

A. General

Reinforcement for wyes, tees, outlets, and nozzles shall be designed in accordance with AWWA Manual M-11. Reinforcement shall be designed for the design pressure specified or shown and shall be in accordance with the details shown. Specials and fittings shall be equal in pressure design strength and shall have the same lining and coating as the adjoining pipe. Unless otherwise shown, the minimum radius of elbows shall be 2.5 times the pipe diameter and the maximum miter angle on each section of the elbow shall not exceed 11-1/4 degrees.

B. Specials and fittings that cannot be mechanically-lined shall be lined by hand-application, using the same materials as are used for the pipe and in accordance with the applicable AWWA or ASTM Standards. Coating applied in this manner shall provide protection equal to that specified for the pipe. Fittings may be fabricated from pipe that has been mechanically lined and/or coated. Areas of lining and coating that have been damaged by such fabrication shall be repaired by hand-applications in accordance with applicable AWWA or ASTM Standards.

C. Access manholes with covers shall be as detailed. All threaded outlets shall be forged steel suitable for 3000 psi service, and shall be as manufactured by Vogt or equal.

D. Moderate deflections and long radius curves may be made by means of beveled joints, by pulling standard joints, by using short lengths of pipe, or a combination of these methods; provided that pulled joints shall not be used in combination with bevels. The maximum total allowable angle for beveled joints shall be 5 degrees per pipe joint. Bevels shall be provided on the bell ends. Mitering of the spigot ends will not be permitted. The maximum allowable angle for pulled joints shall be in accordance with the manufacturer's recommendations or the angle which results from a 3/4-inch pull out from normal joint closure, whichever is less. All horizontal deflections or fabricated angles shall fall on the alignment. In congested city streets or at other locations where underground obstructions may be encountered, the chord produced by deflecting the pipe shall be no further than 6 inches from the alignment shown.

E. All vertical deflections shall fall on the alignment and at locations adjacent to underground obstructions, points of minimum earth cover, and pipeline outlets and structures, the pipe angle points shall match the angle points shown.

F. Outlets, Tees, Wyes, and Crosses

Outlets 12-inch and smaller may be fabricated from Schedule 40 or heavier steel pipe in the standard outside diameters, i.e., 12-3/4-inch, 10-3/4-inch, 8-5/8-inch, 6-5/8-inch, and 4-1/2-inch.

G. The design of outlet reinforcement shall be in accordance with the procedures given in Chapter 13 of AWWA Manual M-11, except that the design pressure, P, used in the M-11 procedure shall equal the field hydrotest pressure. Unless otherwise shown, outlets 2 inches in diameter and smaller need not be reinforced.

H. In lieu of saddle or wrapper reinforcement as provided by the design procedure in Manual M-11, pipe or specials with outlets may be fabricated in their entirety of steel plate having a thickness equal to the sum of the pipe wall plus the required reinforcement.

I. Where required by the M-11 design procedure crotch plate reinforcement shall be furnished.

J. Steel Welding Fittings

Steel welding fittings shall conform to ASTM A 234.

K. Ends for Groove-Type Couplings

Except as otherwise provided herein, where mechanical-type couplings are indicated, the ends of pipe shall be banded with Type C collared ends using double fillet welds. Where pipe 12-inch and smaller is furnished in standard schedule thicknesses, and where the wall thickness equals or exceeds the coupling manufacturer's minimum wall thickness, the pipe ends may be grooved.

L. Lining

All requirements pertaining to thickness, application and curing of lining specified for straight pipe shall apply to specials, with the following provisions: If the special cannot be lined centrifugally, it shall be lined by hand. In such case, the lining shall be reinforced with 2-in by 4-in by No. 12 welded wire fabric positioned approximately in the center of the lining. The wires spaced 2-in on centers shall extend circumferentially around the pipe with the fabric securely fastened to the pipe. Splices shall be lapped 4 inches and the free ends tied or looped to assure continuity.

M. Coating

All requirements pertaining to thickness, application and curing of coating specified for straight pipe shall apply to specials.

N. Marking

A mark indicating the true vertical axis of the special shall be placed on the top and bottom of the special.

PART 3 -- EXECUTION

3.1 GENERAL

A. Unless otherwise provided, the Contractor shall furnish and install all fittings, closure pieces, bends, reducers, wyes, tees, crosses, outlets, manifolds, and other steel plate specials, bolts, nuts, gaskets, jointing materials, and all other appurtenances as shown and as required to provide a complete and workable installation. Where pipe support details are shown, the supports shall conform thereto and shall be placed as indicated; provided, that the support for all exposed piping shall be complete and adequate regardless of whether or not supporting devices are specifically shown. Where shown, concrete thrust blocks and welded joints shall be provided. At all times when the Work of installing pipe is not in progress, all openings into the pipe and the ends of the pipe in trenches or structures shall be kept tightly closed to prevent entrance of animals and foreign materials. The Contractor shall take all necessary precautions to prevent the pipe from floating due to water entering the trench from any source. The Contractor shall assume full responsibility for any damage due to this cause and shall at its own expense restore and replace the pipe to its specified condition and grade if it is displaced due to floating. The Contractor shall maintain the inside of the pipe free from

foreign materials and in a clean and sanitary condition until its acceptance by the Engineer.

3.2 LAYING

A. Trenches shall be in a reasonable dry condition when the pipe special is laid. Necessary facilities including slings shall be provided for lowering and properly placing the pipe sections in the trench without damage. The pipe and specials shall be laid to the line and grade shown and they shall be closely jointed to form a smooth flow line.

Immediately before placing each section of pipe in final position for jointing, the bedding for the pipe shall be checked for firmness and uniformity of surface.

- END OF SECTION -

SECTION 33 12 00 - WATER UTILITY DISTRIBUTION EQUIPMENT

PART 1 -- GENERAL

1.1 DESCRIPTION

A. This section specifies the following appurtenances:

1. Manways
2. Gaskets
3. Hardware

1.2 SUBMITTALS

A. General

1. Submit shop drawings in accordance with Section 01 33 00 Submittal Procedures.
2. Dimensioned fabrication Drawings showing the entire assembly including, but not limited to, a materials list, sizes, piping connections, ASTM designations where appropriate, thicknesses, construction, and description of major components and other structural members, appurtenances, and devices.
3. Performance data for each device over the specified range of pressure, capacity and flows.
4. Installation procedures.
5. Factory test reports.
6. Manufacturer affidavit of compliance to the specifications and requirements herein.

1.3 REFERENCE STANDARDS

A. American National Standards Institute (ANSI)

1.	ANSI B1.1	Unified Inch Screw Threads (UN and UNR Thread Form)
2.	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 125 and 250
3.	ANSI B16.5	Steel Pipe Flanges, Flanged Valves, and Fittings
4.	ANSI B18.2.1	Square and Hex Bolts and Screws (Inch Series)

B. American Society for Testing and Materials (ASTM)

1.	ASTM A48	Gray Iron Castings

2. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

3. ASTM A105 Carbon Steel Forgings for Piping Applications

4. ASTM A106 Seamless Carbon Steel Pipe for High-Temperature Service

5. ASTM A126 Gray Iron Castings For Valves, Flanges and Pipe Fittings

6. ASTM A216 Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service

7. ASTM A242 High-Strength Low-Alloy Structural Steel

8. ASTM A276 Stainless and Heat-Resisting Steel Bars and Shapes

9. ASTM A307 Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

10. ASTM A320 Stainless Steel Bolts, Nuts and Washers

11. ASTM A536 Ductile Iron Castings

12. ASTM B584 Copper Alloy Sand Castings for General Applications

13. ASTM D48 Gray Iron Castings

C. American Water Works Association (AWWA)

1. AWWA C111 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

2. AWWA C207 Steel Pipe Flanges for Waterworks Service – Sizes 4-inch Through 144-inch

3. AWWA C800 Underground Service Line Valves and Fittings

D. National Sanitation Foundation (NSF)

1. NSF 61 Drinking Water System Components, Health Effects

1.4 QUALIFICATIONS

A. Single Manufacturer: Provide appurtenances by the same manufacturer where two or more appurtenances of the same type are required.

B. Unit Responsibility: A single manufacturer for each item specified shall be made responsible for coordination of design, assembly, testing and furnishing of each item of the same kind.

C. Conform factory testing to the applicable requirements of ASTM, AWWA, and ANSI standards.

1.5 DELIVERY, HANDLING, STORAGE, AND PROTECTION

A. General

1. Deliver equipment and materials in a clean and undamaged condition and store off the ground. Close-up ends of equipment at the factory and maintain closed until installed. Replace defective or damaged materials with new materials at no additional cost to City of Thornton.

2. Take care in loading, transporting, and unloading to prevent injury to the valve, appurtenances, or coatings. Do not drop equipment. Examine appurtenances before installation. Do not install any equipment that is found to be defective. Repair damage to coatings. Apply manufacturer recommended lubricants where required.

3. Coat all gears, bearing surfaces, and other surfaces not to be painted with a heavy coat of grease or other suitable rust resistant coating unless otherwise specified herein. Maintain this coating required to prevent corrosion during any period of storage and installation.

4. Remove and replace any defective equipment with non-defective equipment at no additional cost to City of Thornton.

PART 2 -- MATERIALS

2.1 MANWAYS

A. Bolts and Nuts: Bolts and nuts shall be carbon steel, ASTM A307 Grade B Bolts shall have regular hexagonal heads, and nuts shall have regular square or hexagonal dimensions, all in accordance with ANSI/ASME B18.2.1 for wrench head bolts and nuts and wrench openings. All bolts and nuts shall be threaded in accordance with ANSI/ASME B1.1 for screw threads, coarse-threaded series, class 2A and 2B fit.

B. Carbon nuts and bolts shall be covered with cold-applied wax tape coating system such as Trenton #1 wax tape in accordance with manufactures instructions, NACE RP0375, and AWWA C 217. Wax tape shall be covered with plastic wrap.

2.2 GASKETS

A. Non-insulated

Gaskets for flanged joints shall be full-faced, non-segmented, 1/8-inch thick compressed sheets of premium rubber sheets, non-stick coating, suitable for temperatures to 200 degrees F, and pressures to 250 psig. Blind flanges shall have gaskets covering the entire inside face of the blind flange and shall be cemented to the blind flange. Ring gaskets shall not be permitted. Flange gasket manufacturers shall be Garlock, style 22-Red SBR Rubber, or approved equal.

B. Insulated

Gaskets for flanged joints shall be full-faced, non-segmented, 1/8-inch thick compressed sheets of premium rubber sheets, non-stick coating, suitable for temperatures to 200 degrees F, and pressures to 250 psig. Blind flanges shall have gaskets covering the entire inside face of the blind flange and shall be cemented to the blind flange. Ring gaskets shall not be permitted. Flange gasket manufacturers shall be Garlock, style 22-Red SBR Rubber, or approved equal. Along with the gasket, shall be one piece phenolic sleeve and washers along with a metal washer.

2.3 HARDWARE

A. All stainless steel bolts shall be coated in anti-seize before installation. The lubrication shall be synthetic based, graphite anti-seize paste for stainless steel bolts.

PART 3 – NOT USED

- END OF SECTION -